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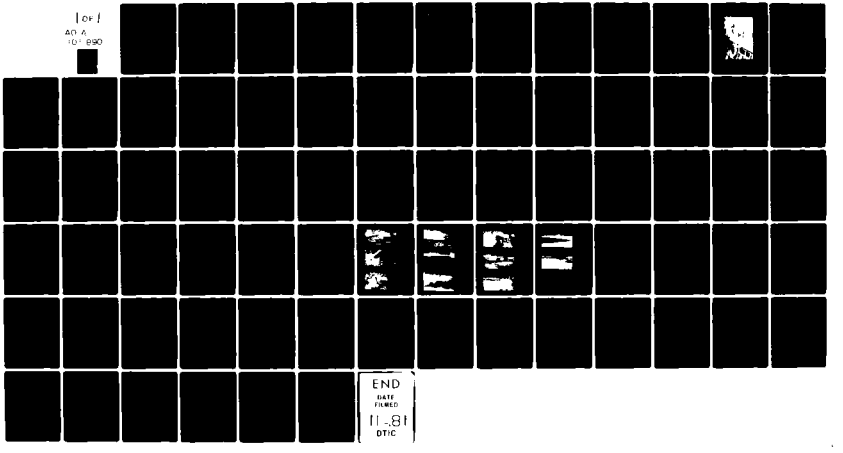

MISSOURI-KANSAS CITY BASIN

AD A105890

COLUMBIA MUNICIPAL GOLF COURSE DAMS

BOONE COUNTY, MISSOURI

MO 10895

MO 11068

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY: HOSKINS-WESTERN-SONDEREGGER, INC.

FOR: STATE OF MISSOURI

SEPTEMBER, 1978

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REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER / 2. GOVT ACCESSION NO. AD-A105890	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Dam Inspection Report National Dam Safety Program Columbia Municipal Golf Course Lake Dams Boone County, Missouri (MO 10895) & (MO 11068)	5. TYPE OF REPORT & PERIOD COVERED Final Report 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Hoskins-Western-Sonderegger, Inc.	8. CONTRACT OR GRANT NUMBER(s) DACW43-78-C-0155
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101	12. REPORT DATE September 1978 13. NUMBER OF PAGES Approximately 60
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)	15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

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17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dam Safety, Lake, Dam Inspection, Private Dams, Upper Lake Dam, Lower Lake Dam

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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PREFACE

DIVISION I OF THIS REPORT IS THE PHASE I INSPECTION REPORT FOR COLUMBIA MUNICIPAL GOLF COURSE LOWER LAKE DAM.

DIVISION II IS THE PHASE I INSPECTION REPORT FOR COLUMBIA MUNICIPAL GOLF COURSE UPPER LAKE DAM.

APPENDIX A, APPENDIX B, APPENDIX C & APPENDIX D CONTAIN INFORMATION PERTINENT TO BOTH DAMS.

DIVISION I OF II

COLUMBIA MUNICIPAL GOLF COURSE LOWER LAKE DAM

BOONE COUNTY, MISSOURI

MISSOURI INVENTORY NO. 10895

PHASE I INSPECTION REPORT

(6) NATIONAL DAM SAFETY PROGRAM.

Columbia Municipal Golf Course Lower Lake Dam (MO 10895) and Columbia Municipal Golf Course Upper Lake Dam (MO 11068). Boone County, Missouri. Phase I Inspection Report.

PREPARED BY
HOSKINS-WESTERN-SONDEREGGER, INC.
CONSULTING ENGINEERS
LINCOLN, NEBRASKA

Appendix A - D.

(9) Final rept.

UNDER DIRECTION OF (15) DACW43-78-C-Ø155

ST. LOUIS DISTRICT, CORPS OF ENGINEERS

FOR

GOVERNOR OF MISSOURI

(11) SEP[redacted]1978

(12) 74

DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: Columbia Municipal Golf Course Lower Lake Dam
Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Columbia Municipal Golf Course Lower Lake Dam:

It was prepared under the National Program of Inspection of Non-Federal Dams

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

1) Spillway will not pass 50 percent of the Probable Maximum Flood
2) Overtopping could result in dam failure.
3) Dam failure significantly increases the hazard to loss of life downstream.

SUBMITTED BY: SIGNED
Chief, Engineering Division

12 MAR [illegible]
Date

APPROVED BY: SIGNED
Colonel, CE, District Engineer

5 MAR 1979
Date

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
COLUMBIA MUNICIPAL GOLF COURSE LOWER LAKE DAM
MO 10895

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*Lower and Upper Dams

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam	Columbia Municipal Golf Course Lower Lake Dam
State Located	Missouri
County Located	Boone County
Stream	Tributary to Harmony Creek
Date of Inspection	September 13, 1978

Columbia Municipal Golf Course Lower Lake Dam No. Mo. 10895 was inspected by an interdisciplinary team of engineers from Hoskins-Western-Sonderegger, Inc. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines, this dam does not meet the requirements as a small size dam. However, there is a high downstream hazard associated with this dam. Because of this high downstream hazard and a dam immediately upstream of Mo. 10895, the safety of Columbia Municipal Golf Course Lower Lake Dam has been addressed and documented in this report. Failure would threaten life and property. The estimated damage zone extends one-half mile downstream of the dam. Within the damage zone are six to eight houses and one state highway crossing.

Our inspection and evaluation indicates that the spillway does not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. Since the dam has a low height and small storage capacity, the spillway should be capable of passing one-half of the Probable Maximum Flood. The spillway will pass 10% of the Probable Maximum Flood without overtopping the dam. Also the spillway will not pass the 100-year flood without overtopping of the dam. The Probable Maximum Flood (PMF) is defined as the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These analyses should be obtained in the future.

Deficiencies visually observed by the inspection team were inlet channel to the spillway overgrown with trees and shrubs and the channel downstream from outlet end of spillway badly overgrown with trees and shrubs.

Several items of preventive maintenance need to be initiated by the owner. These are described in detail in the body of the report.

H. P. Hoskins

Harold P. Hoskins, P.E.
Hoskins-Western-Sonderegger, Inc.
Lincoln, Nebraska

PHOTO NO. 1
OVERVIEW OF COLUMBIA
MUNICIPAL GOLF COURSE DAMS
UPPER DAM AT BOTTOM CENTER

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
COLUMBIA MUNICIPAL GOLF COURSE LOWER LAKE DAM
ID NO. MO. 10895

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection of Columbia Municipal Golf Course Lower Lake Dam be made.

b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams". These guidelines were developed with the help of several Federal agencies and many State agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances.

(1) The dam is a small earth fill located along the west boundary of the municipal golf course in Columbia, Missouri. Another golf course dam and lake is located about 700 feet upstream from this dam. The crest elevation of the upper dam is 18 feet ± above the crest elevation of this (the lower) dam. Land surrounding the lake and dam is gently rolling and utilized as a park and golf course.

(2) The uncontrolled spillway consists of a 24 inch diameter corrugated metal pipe approximately 20 feet long located on the left (south) abutment. (℄ station 0+00)

(3) Pertinent physical data are given in paragraph 1.3 below.

b. Location. The dam is located in the central portion of Boone County, Missouri, as shown on Plate A-2. The dam and the lake formed by the dam is shown on Plate A-1 in the E 1/2 of Section 3, T48N, R13W.

c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. Based on these criteria, this dam and impoundment does not meet the classification as a small size dam.

d. Hazard Classification. Guidelines for determining hazard classification are presented in the same guidelines as referenced in paragraph c above. Based on referenced guidelines, this dam is in the High Hazard Classification. The estimated damage zone extends one-half mile downstream of the dam. Within the damage zone are six to eight houses and one state highway crossing.

e. Ownership. The dam is owned by the City of Columbia, Missouri, Parks and Recreation Department, P. O. Box N, Columbia, Missouri 65201, Attention: Dick Green, Parks and Recreation Director.

f. Purpose of Dam. The dam forms a 5 acre lake used as a fairway water hazard and for irrigation of the greens.

g. Design and Construction History. No design or construction data were available for this dam. It was reported that the dam was built in the 1950's.

h. Normal Operating Procedures. There are no controlled outlet works for this dam. It was reported that water flows through the spillway 2 or 3 times every year. It was also reported that water flows over the north end of the dam (about ℄ station 2+50 - see Appendix C) in the spring of almost every year. The overtopping of the dam occurs when the emergency spillway is operating on the upper dam.

1.3 PERTINENT DATA

a. Drainage Area - 150 acres. (Total equals 104 acres lower dam + 46 acres upper dam.)

b. Discharge at Damsite.

(1) All discharges at the damsites are as follows:

(a) Lower Dam (#MO 10895) - All discharge is through an uncontrolled 24 inch diameter corrugated metal pipe culvert principal spillway set at grade.

(b) Upper Dam - All discharge reaches the lower dam through an uncontrolled 6 inch diameter cast iron pipe principal spillway and a grassed earth channel ungated emergency spillway. Division II of this report covers the Phase I inspection of the Upper dam.

(2) Estimated maximum flood at the lower damsite - 215 c.f.s. outflow or overflow estimated from statements by owners. A flood of this magnitude has occurred more than once in recent years according to statements by the owner.

(3) The lower damsite principal spillway capacity varies from 0 c.f.s. at its crest elevation (718.5 M.S.L.) to 13.1 c.f.s. at the minimum dam crest (elevation 720.7 M.S.L.).

c. Elevations (Feet Above M.S.L.).

(1) Top of dam - 721.0.

(2) Principal spillway crest - 718.5.

(3) Emergency spillway crest - none.

(4) Streambed at center line dam - 705.9.

(5) Maximum tailwater - 715± for 1/2 PMF.

d. Reservoir. Length of maximum pool - 800±.

e. Storage (Acre-feet). Top of dam - 20.4.

f. Reservoir Surface (Acres).

(1) Top of dam - 5±.

(2) Principal spillway crest - 3.3±.

g. Dam.

(1) Type - earth embankment.

(2) Length - 320 feet ±.

(3) Height - 15 feet ±.

(4) Top width - 11 feet ±.

(5) Side slopes.

(a) Downstream - 2.3 to 2.5H on 1V (measured).

(b) Upstream - 2.5±H on 1V (measured).

(6) Zoning - unknown.

(7) Impervious core - unknown.

(8) Cutoff - unknown.

(9) Grout curtain - unknown.

(10) Wave protection - none.

h. Diversion Channel and Regulating Tunnel - None.

i. Spillway.

(1) Principal.

(a) Type - Uncontrolled 24 inch diameter corrugated metal pipe culvert set at grade. The inlet is a simple sharp edged protrusion of the pipe into the approach channel with no headwall or other improvements.

(b) Crest (invert) elevation - 718.5. Outlet - 717.7.

(c) Length - 20 feet ±.

(2) Emergency - None.

j. Regulating Outlets.

(1) Principal spillway - None.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design data were available for this dam.

2.2 CONSTRUCTION

No construction data were available. It was reported that the dam was constructed in the 1950's.

2.3 OPERATION

No data on the operation of the spillway were available. It was reported that the spillway operates every year and that the dam overtops many years as discussed in Section 1.2, paragraph h.

2.4 EVALUATION

a. Availability. No data were available.

b. Adequacy. The field surveys and visual observations presented herein are considered adequate to support the conclusions of this report. Seepage and stability analyses comparable to the requirements of the guide lines are not on record. This is a deficiency which should be rectified.

c. Validity. Not applicable.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of the Columbia Municipal Golf Course Lower Lake Dam was made on September 13, 1978. Engineers from Hoskins-Western-Sonderegger, Inc., Lincoln, Nebraska making the inspection were: Rey S. Decker, Geology and Soil Mechanics; Garold Ulmer, Civil Engineer; Gordon Jamison and Richard Walker, Hydrology. The following personnel from the City Parks and Recreation Department accompanied the inspection party: Bill Lockwood, Bruce Murray and Bill Ricks. Specific observations are discussed below.

b. Dam. The embankment slopes are well vegetated with adapted grasses. Soils in the embankment and abutments appear to be lean clay (CL). No cracks, slips or abnormal deformations were noted on the embankment or abutments. No seeps were apparent on the downstream slope or along the downstream toe. No significant wave erosion was noted on the upstream face of the dam.

Rough measurements along the center line of the dam indicate that the right (north) end of the dam is one foot or more lower in elevation than the remainder of the dam. (See Appendix C).

c. Appurtenant Structures. The spillway consists of a 24 inch corrugated metal pipe approximately 20 feet long located in the left abutment at ℄ station 0+00. The invert elevation of the spillway is approximately 2.5 feet below the top of dam. The forebay or inlet channel to the spillway is badly choked with trees and shrubs.

d. Reservoir Area. No excessive wave wash or erosion or slides were noted along the shore of the lake.

e. Downstream Channel. The spillway discharges into an earth channel that is badly overgrown with trees and shrubs. The channel passes under State Highway E in a concrete box (approximately 5.5' x 6') some 50 feet downstream from the dam. The channel below the roadway is also overgrown with trees and shrubs. Several homes are located along a street which runs westward almost perpendicular to the center line of the dam downstream from the right end of the dam (about ℄ station 3+00). The back yards of these homes encroach upon the outlet channel for the spillway.

3.2 EVALUATION

The spillway will not pass the floods to be expected every one to two years. However, there was no evidence of flood damage on or below the dam from the frequent overtopping that reportedly occurs. Additional studies would be required to determine flood damages from overtopping by the probable maximum flood. Removal of trees and shrubs from the inlet section and from the outlet channel would improve the operation of the spillway.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

There are no controlled outlet works for this dam. The pool level is controlled by rainfall, evaporation and the capacity of the uncontrolled spillway. It was reported that the spillway operates every year and that the dam overtops almost every year.

4.2 MAINTENANCE

The heavy growth of trees and shrubs in the inlet and outlet section of the spillway indicates the lack of regular maintenance in those areas.

4.3 MAINTENANCE AND OPERATING FACILITIES

No operating facilities exist at this dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no warning system in effect for this dam.

4.5 EVALUATION

A serious potential of failure may result if the deficiencies in reservoir storage and spillway capacity are not corrected.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. No hydraulic or hydrologic data were available from the owner. All computations are based on the survey made during the inspection and upon information taken from the 7 1/2' quadrangle sheet. These are summarized and attached in Appendix D.

b. Experience. The drainage areas and elevation-area-storage curves were developed from the USGS Columbia, Missouri 7 1/2' quadrangle sheet. The hydraulic computations for spillway and dam overtopping ratings were based on data taken during the inspection field survey. Both the lower dam (MO 10895) and the upper dam on the watershed were surveyed during the inspection.

c. Visual Observations.

(1) The principal spillway is in fair condition. The short approach channel has trees and brush growing in it. The culvert pipe itself has a very shallow cover and could move or be washed out at high flows overtopping the crest.

(2) The box culvert under the road immediately downstream from the dam could result in ponding against the downstream toe of the dam. An estimate has been made of the maximum tailwater at 1/2 PMF (Section 1.3 c 5).

(3) The lower dam has been overtopped numerous times during its existence. The overtopping occurs along the crest near the right abutment (according to the conference with the owners). However, the field inspection showed no evidence of damage to the gravel surfaced golf cart pathway on the crest. The obvious frequency of overtopping from the hydrologic computations summarized below would be a matter of concern.

(4) The upper dam is of importance in the hydrologic analysis of the overtopping potential of the lower dam. The hydrologic effect of the upper dam has been considered in all routing computations summarized below.

d. Overtopping Potential. The spillway is too small to pass the PMF, 1/2 PMF, or 100-year flood without overtopping. The spillway will just pass 10% of the PMF without overtopping. This 0.10 PMF flow has a greater frequency (lesser return period) than the 100-year flood. The results of the routings

are tabulated in regards to the following conditions. The flows tributary to the upper dam on the watershed were (see Map Plate A1) routed through storage of the upper dam and then combined with flows tributary to the lower dam alone to form the inflow hydrographs to the lower dam.

Frequency	Peak Inflow Discharge c.f.s	Peak Inflow Discharge c.f.s	Maximum Pool Elevation M.S.L.	Freeboard Top of Dam Min. Elev. 721.0	Time Dam Overtopping Hrs.
100-Year	245	235	721.5	-0.5	5.2
1/2 PMF	660	640	722.0	-1.0	9.2
PMF	1490	1470	722.5	-1.5	16.0
0.10 PMF	89	38	721.0	0	0

According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, this dam is classified as having a high hazard. Since the dam has a low height and small storage capacity the spillway should be capable of passing one-half of the Probable Maximum Flood.

The St. Louis District, Corps of Engineers, in a letter dated 11 August, 1978 has estimated the damage zone extending one half mile downstream of the dam. Within the damage zone are six to eight houses and one state highway crossing. Field inspection of the downstream damage zone showed that at least these number of structures were exposed to hazard.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. The dam appears to be structurally stable. The embankment slopes should provide adequate safety factors against shear failures for a dam of this height. There were no seeps, slides or deformations noted on the embankment or abutments. Additional studies would be required to determine the affects of overtopping on structural stability.

b. Design and Construction Data. No design or construction data were available.

c. Operating Records. There are no controlled operating facilities for this dam.

d. Post Construction Changes. The inspection team is not aware of any post construction changes on this dam.

e. Seismic Stability. This dam is located in Seismic Zone 1. An earthquake of the magnitude predicted in this zone is not expected to cause a structural failure of this dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. Floods caused by 10% of the maximum design flood (PMF) will overtop the dam. The effect of such overtopping on the structural or erosional stability of the dam and on potential damages downstream from the dam is not known.

b. Adequacy of Information. Due to the lack of engineering data, the conclusions in this report are based upon performance history and visual observations. Seepage and stability analyses comparable to the requirements of the guidelines were not available, which is considered a deficiency.

c. Urgency. The remedial measures recommended in paragraph 7.2 should be accomplished in the near future.

d. Necessity for Phase II. Phase II investigation is not considered necessary.

e. Seismic Stability. This dam is located in Seismic Zone I. An earthquake of this magnitude is not expected to be hazardous to this dam.

7.2 REMEDIAL MEASURES

a. Alternatives

(1) Additional information should be obtained on the topographic characteristics of the reservoir area to determine the increase in the size of the spillway and/or the height of the dam that is necessary to pass the probable maximum flood without overtopping the dam. If the height of the dam is increased, additional investigations and analyses should be conducted to determine the structural characteristics and stability of the present embankment and the stability against seepage and shear failure of the modified dam. The services of an engineer experienced in the design of dams should be obtained to evaluate the present dam and to design the new structure and/or spillway.

b. O & M Maintenance and Procedures

When remedial measures to prevent overtopping of the dam are completed, a schedule of regular inspection and maintenance should be initiated. This maintenance schedule should be designed to control vegetation on the structure.

Trees and shrubs presently growing in the inlet and outlet channels of the spillway should be removed and measures taken to prevent their recurrence.

DIVISION II OF II

COLUMBIA MUNICIPAL GOLF COURSE UPPER LAKE DAM

BOONE COUNTY, MISSOURI

MISSOURI INVENTORY NO. 11068

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

PREPARED BY
HOSKINS-WESTERN-SONDEREGGER, INC.
CONSULTING ENGINEERS
LINCOLN, NEBRASKA

UNDER DIRECTION OF

ST. LOUIS DISTRICT, CORPS OF ENGINEERS

FOR

GOVERNOR OF MISSOURI

SEPTEMBER 1978

DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: Columbia Municipal Golf Course Upper Lake Dam
Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Columbia Municipal Golf Course Upper Lake Dam:

It was prepared under the National Program of Inspection of Non-Federal Dams

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

1) Spillway will not pass 50 percent of the Probable Maximum Flood
2) Overtopping could result in dam failure.
3) Dam failure significantly increases the hazard to loss of life downstream.

SUBMITTED BY: SIGNED
Chief, Engineering Division

12 MAR 1979
Date

APPROVED BY:
Colonel, CE, District Engineer

5 MAR 1979
Date

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
COLUMBIA MUNICIPAL GOLF COURSE UPPER LAKE DAM
MO 11068

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*Lower and Upper Dams

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam	Columbia Municipal Golf Course Upper Lake Dam
State Located	Missouri
County Located	Boone County
Stream	Tributary to Harmony Creek
Date of Inspection	September 13, 1978

Columbia Municipal Golf Course Upper Lake Dam No.Mo.11068 was inspected by an interdisciplinary team of engineers from Hoskins-Western-Sonderegger, Inc. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines, this dam is classified as a small size dam with a high downstream hazard potential. Failure would threaten life and property. The estimated damage zone extends one-half mile downstream of the dam. Within the damage zone are Columbia Municipal Golf Course Lower Lake Dam, six to eight houses and one state highway crossing.

Our inspection and evaluation indicates that the spillways do not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. Since the dam has a low height and small storage capacity the spillways should be capable of passing one-half of the Probable Maximum Flood. The spillways will pass the 100 year flood (flood having a one percent chance of being exceeded in any year) without overtopping the dam. The spillways will pass 35% of the Probable Maximum Flood without overtopping the dam. The Probable Maximum Flood (PMF) is defined as the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These analyses should be obtained in the future.

No other deficiencies were observed by the inspection team.

No preventative maintenance items are called for in the report. The dam is well maintained on a regular basis.

H. P. Hoskins

Harold P. Hoskins, P.E.
Hoskins-Western-Sonderegger, Inc.
Lincoln, Nebraska

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM
COLUMBIA MUNICIPAL GOLF COURSE UPPER LAKE DAM - MO 11068
BOONE COUNTY, MISSOURI

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection of Columbia Municipal Golf Course Upper Lake Dam be made.

b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams". These guidelines were developed with the help of several Federal agencies and many State agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances.

(1) The dam is a small earth fill located in the southwestern section of the Columbia Municipal Golf Course, Columbia, Mo. The golf course lower dam and lake, MO 10895, is located about 700 feet downstream from this dam. The crest elevation of this dam is 18 feet ± above the crest elevation of the lower dam.

(2) The principal spillway consists of an ungated 6 inch diameter cast iron pipe with a hooded inlet passing through the dam at about ℄ station 2 + 15.

(3) A vegetated earth emergency spillway is cut into the left abutment.

(4) Pertinent physical data are given in paragraph 1.3 below.

b. Location. The dam is located in the central portion of Boone County, Missouri, as shown on Plate A-2. The dam and the lake formed by the dam is shown on Plate A-1 in the E½ of Section 3, T48N, R13W.

c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. Based on these criteria, this dam and impoundment is in the small size category.

d. Hazard Classification. Guidelines for determining hazard classification are presented in the same guidelines as referenced in paragraph c above. Based on referenced guidelines, this dam is in the High Hazard Classification. The estimated damage zone extends one-half mile downstream of the dam. Within the damage zone are the Columbia Municipal Golf Course Lower Lake Dam, six to eight houses and one state highway crossing.

e. Ownership. The dam is owned by the City of Columbia, Missouri, Parks and Recreation Department, P.O. Box N, Columbia, Missouri 65201. Attention: Dick Green, Parks and Recreation Director

f. Purpose of Dam. The dam forms a 7 acre recreational lake (based on elevation of principal spillway).

g. Design and Construction History. No design or construction data were available for this dam. It was reported that the dam was constructed in the early 1950's. The downstream slope of the dam was rebuilt in 1976.

h. Normal Operating Procedure. There are no controlled outlet works for this dam. It was reported that the emergency spillway operates almost every year and that spillway flow from this dam usually causes overtopping of the lower dam.

1.3 PERTINENT DATA

a. Drainage Area. 46 acres (determined by consultant)

b. Discharge At Damsite.

(1) All discharges at the damsite are as follows. All discharges to the lower damsite (MO 10895) are through an uncontrolled 6 inch diameter cast iron pipe principal spillway and a grassed earth channel ungated emergency spillway in the left abutment hillside.

(2) Estimated maximum flood at the upper damsite 50 c.f.s. outflow or overflow estimated from statements by owners. A flood of this estimated magnitude has occurred more than once in

recent years according to statements by the owners. Maximum pool of the upper dam is considered to be minimum crest elevation 738.4 Feet M.S.L.

(3) The principal spillway capacity varies from 0 c.f.s. at its crest elevation 735.8 M.S.L. to 1.5 c.f.s. at the minimum top of dam.

(4) The emergency spillway capacity varies from 0 c.f.s. at its crest elevation 736.7 M.S.L. to 89.0 c.f.s. at the minimum top of dam.

(5) Total spillway capacity at the minimum top of dam is 90.5 c.f.s. ±

c. Elevations. (Feet above M.S.L.)

(1) Top of dam - 738.8 Feet M.S.L.

(2) Principal spillway crest - 735.8

(3) Emergency spillway crest - 736.7

(4) Streambed at centerline - 722 ±

(5) Maximum tailwater - 722 ±

d. Reservoir. Length (feet) of maximum pool - 900 ±

e. Storage (Acre-feet).

(1) Top of dam - 51.1

(2) Principal spillway crest - 28.5

f. Reservoir Surface (Acres).

(1) Top of dam - 9 ±

(2) Principal spillway crest - 7 ±

g. Dam.

(1) Type - Earth embankment

(2) Length - 490 feet ±

(3) Height - 17 feet ±

(4) Top width - 14 feet ±

(5) Side slopes.

(a) Downstream - 4.5H on 1V (measured)

(b) Upstream - 3.7H on 1V (measured)

(6) Zoning - unknown

(7) Impervious core - unknown

(8) Cutoff - unknown

(9) Grout curtain - unknown

(10) Wave protection - none

h. Diversion Channel and Regulating Tunnel. None

i. Spillway.

(1) Principal

(a) Type - uncontrolled 6 inch diameter cast iron pipe placed through the dam on a grade of about 13 percent. The inlet is an angled cut on the end of the pipe (hooded inlet).

(b) Crest (invert) elevation - 735.8 (M.S.L.)

Outlet - 722 ± (M.S.L.)

(c) Length - 104 feet ±

(2) Emergency

(a) Type - vegetated earth

(b) Control section - 18 feet bottom width; 2H on 1V side slopes; approximately 80 feet long from inlet to exit section

(c) Crest elevation - 736.7 feet, (M.S.L.)

(d) Upstream Channel - None direct to reservoir

(e) Downstream Channel - vegetated earth which outlets into the lower lake

j. Regulating Outlets. None

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design data were available for this dam

2.2 CONSTRUCTION

No construction data were available. It was reported that the dam was built in the early 1950's and that the downstream slope was rebuilt in 1976.

2.3 OPERATION

No data were available on spillway operation. It was reported that the emergency spillway operates almost every year.

2.4 EVALUATION

a. Availability. No data were available

b. Adequacy. The field surveys and visual observation presented herein are considered adequate to support the conclusion of this report.

c. Seepage and stability analyses. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

d. Validity. Not applicable.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of the Columbia Municipal Golf Course Upper Lake Dam was made on September 13, 1978. Engineers from Hoskins-Western-Sonderegger, Inc., Lincoln, Nebraska making the inspection were: Rey S. Decker, Geology and Soil Mechanics; Garold Ulmer, Civil Engineer; Gordon Jamison and Richard Walker, Hydrology. The following personnel from the City Parks and Recreation Department accompanied the inspection party: Bill Lockwood, Bruce Murray and Bill Ricks. Specific observations are discussed below.

b. Dam. Soils in the embankment and abutments appear to be lean clay (CL). The embankment slopes are well vegetated with adapted grasses and are well maintained. No cracks, slips or abnormal deformations were noted on the embankment or abutments. No seeps were apparent on the downstream slope or along the downstream toe.

c. Appurtenant Structures.

(1) The principal spillway ("trickle tube") consists of a 6 inch diameter cast iron hooded inlet pipe located through the dam at about ℄ station 2 + 15. The invert elevation of the pipe inlet is about 2.6 feet below the top of the dam. The flow from the pipe spillway discharges into the lower lake through a well stabilized grassed waterway.

(2) The emergency spillway consists of a well vegetated earth channel cut through the abutment on the left end of the dam. This spillway has an 18 foot bottom width and side slopes of 2H on 1V. The elevation of the control section is approximately 2.1 feet below the top of the dam. Flow from the emergency spillway discharges into the lower lake through a stable, grassed waterway.

d. Reservoir Area. No excessive wave wash, erosion, or slides were noted along the shoreline of the lake.

e. Downstream Channel. All spillway discharges from this lake flow into the lower lake through stable grassed waterways which traverse the fairways of the golf course.

3.2 EVALUATION

The dam and appurtenances appear to be in excellent condition. Renovation of the downstream section in 1976 resulted in abnormally flat slopes (4.5H on 1V) for a dam of this height and apparent composition. The factor of safety against shear failure of this dam must be relatively high.

The excellent grass cover and apparent materials in the dam indicate that minor overtopping of the dam would not endanger the safety of the structure.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

There are no controlled outlet works for this dam. The pool level is controlled by rainfall, evaporation, and the capacity of the uncontrolled spillways.

4.2 MAINTENANCE

The dam, appurtenances, and reservoir shoreline are subject to regular and careful maintenance as integral parts of the golf course.

4.3 MAINTENANCE AND OPERATING FACILITIES

No operating facilities exist at this dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no warning system in effect for this dam.

4.5. EVALUATION

There does not appear to be any serious potential of failure of this structure

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. No hydraulic or hydrologic data were available from the owner. All computations are based on the survey made at inspection or are taken from the Columbia, MO. 7½' quadrangle sheet. These are summarized and attached in Appendix D.

b. Experience. The drainage area and elevation - area - storage curves were developed from the USGS Columbia Quadrangle 7½' sheet. Some specific guidance was given by the St. Louis District Corps of Engineers which resulted in the power curve method being used to extend the elevation storage curves below normal pool elevations. The hydraulic computations for spillways and dam overtopping ratings were based on data taken in the inspection field survey. Both the lower dam (MO 10895) and the upper dam (MO 11068) on the watershed were surveyed during the inspection.

c. Visual Observations.

(1) The principal spillway is in good condition but it has a very small hydraulic capacity relative to the 100 year flood.

(2) The emergency spillway is in good condition but it also has a small hydraulic capacity relative to the 100 year and dam overtopping floods.

(3) The pool of the lower dam would extend up to the toe of the upper dam at all inflows greater than ½ PMF.

(4) The emergency spillway operates at least once a year according to statements of the owners representatives. It does not appear to have lost any of its vegetative cover subsequent to this frequency of operation.

d. Overtopping Potential. The spillways of the upper dam are too small to pass 50% of the PMF without overtopping. The spillways will pass 35% of the PMF without overtopping. This 35% of the PMF has a lesser frequency (greater return period) than the 100 year flood. The flows tributary to the upper dam on the watershed were routed through storage of the upper dam and then combined with flows tributary to the lower dam to form the total inflow hydrographs to the lower dam. The results of the routings through the lower dam are given in the report on the lower dam (#MO 10895). (See Division I of this report.)

The results of the routings are tabulated in regards to the following conditions:

COMPILATION OF HYDROLOGIC ROUTINGS UPPER DAM

Frequency	Peak Inflow Discharge c.f.s.	Peak Outflow Discharge c.f.s.	Maximum Pool Elevation M.S.L.	Freeboard Top of Dam Min. Elv. 738.4 ft.M.S.L. (Avg. 738.8)	Time Dam Overtopping HRS.
100 year	96	35	737.6	+0.8	0
1/2 PMF	232	180	738.8	-0.4	2.0
PMF	445	445	739.1	-0.7	4.8
0.35	156	90	738.4	0	0

According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, this dam is classified as having a high hazard rating and a small size. Therefore, 50% of the PMF is the test for the adequacy of the upper dam and its spillways.

The St. Louis District, Corps of Engineers in a letter dated 11 August 1978 has estimated the damage zone as extending one half mile downstream of the lower and upper dams. Within the damage zone are six to eight houses and one state highway crossing. Field inspection of the downstream damage zone showed that at least these number of structures were exposed to hazard, because of their close proximity to the stream channel.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observation. The dam appears to be structurally stable. The embankment slopes should provide adequate safety factors against shear failures for a dam of this height. There were no seeps, slides or deformations noted on the embankment or abutments. Additional studies would be required to determine the affects of overtopping on structural stability. However, it appears that the safety of the dam would not be impaired by minor overtopping.

b. Design and Construction Data. No design or construction data were available.

c. Operating Records. There are no controlled operating facilities for this dam.

d. Post Construction Changes. It was reported that the downstream section of the dam was flattened in 1976. This work was apparently done to repair some minor slip areas and to facilitate regular mowing and maintenance on the slope.

The post construction changes appear to have alleviated any previous problems of slope stability and maintenance.

e. Seismic Stability. This dam is located in Seismic Zone 1, an earthquake of the magnitude predicted in this area is not expected to cause structural failure of this dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. Using the approximate data available for analysis, the dam will be overtopped 0.4 foot by one-half the Probable Maximum Flood. The effect of such overtopping on the structural or erosional stability of the dam is not known.

b. Adequacy of Information. Due to the lack of engineering data, the conclusions in this report are based upon performance history and visual observations. Seepage and stability analyses comparable to the requirements of the guidelines were not available which is considered a deficiency.

c. Urgency. There does not appear to be an immediate urgency to accomplish the remedial measures recommended in paragraph 7.2

d. Necessity for Phase II. Phase II investigation is not considered necessary.

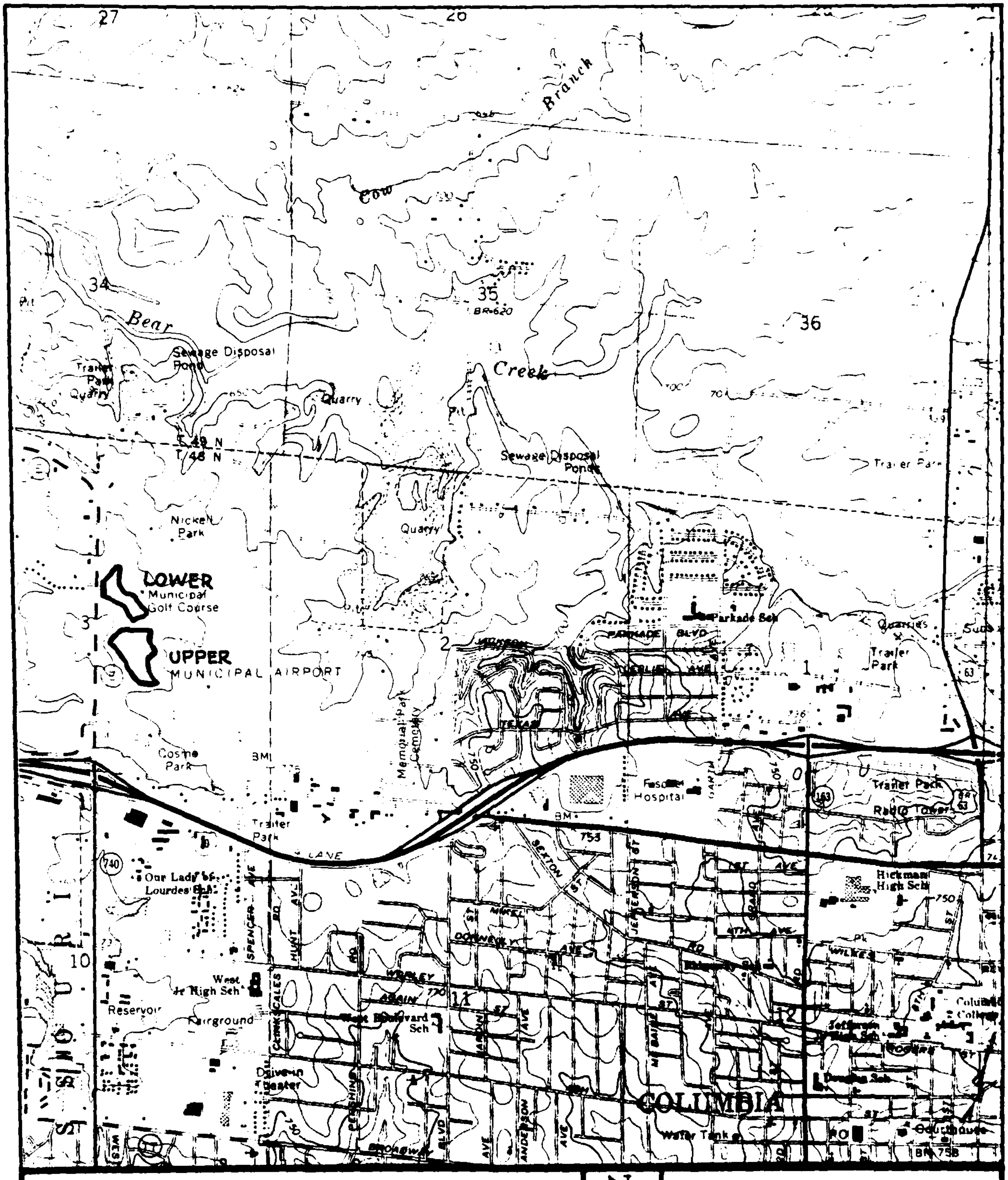
e. Seismic Stability. This dam is located in Seismic Zone 1. An earthquake of this magnitude is not expected to be hazardous to this dam.

7.2 REMEDIAL MEASURES

a. Alternatives.

(1) Additional information should be obtained on the topographic characteristics of the reservoir area to determine the increase in the height of dam or the size of the spillway that is necessary to pass one half the Probable Maximum Flood without overtopping the dam. The services of an engineer experienced in the design of dams should be obtained to evaluate the present reservoir storage capacity, to provide seepage and stability analyses of the present dam, and to design protective measures, if required.

APPENDIX A
MAPS



SCALE IN FEET

2000 1000 0 2000 4000

1000 500 0 1000

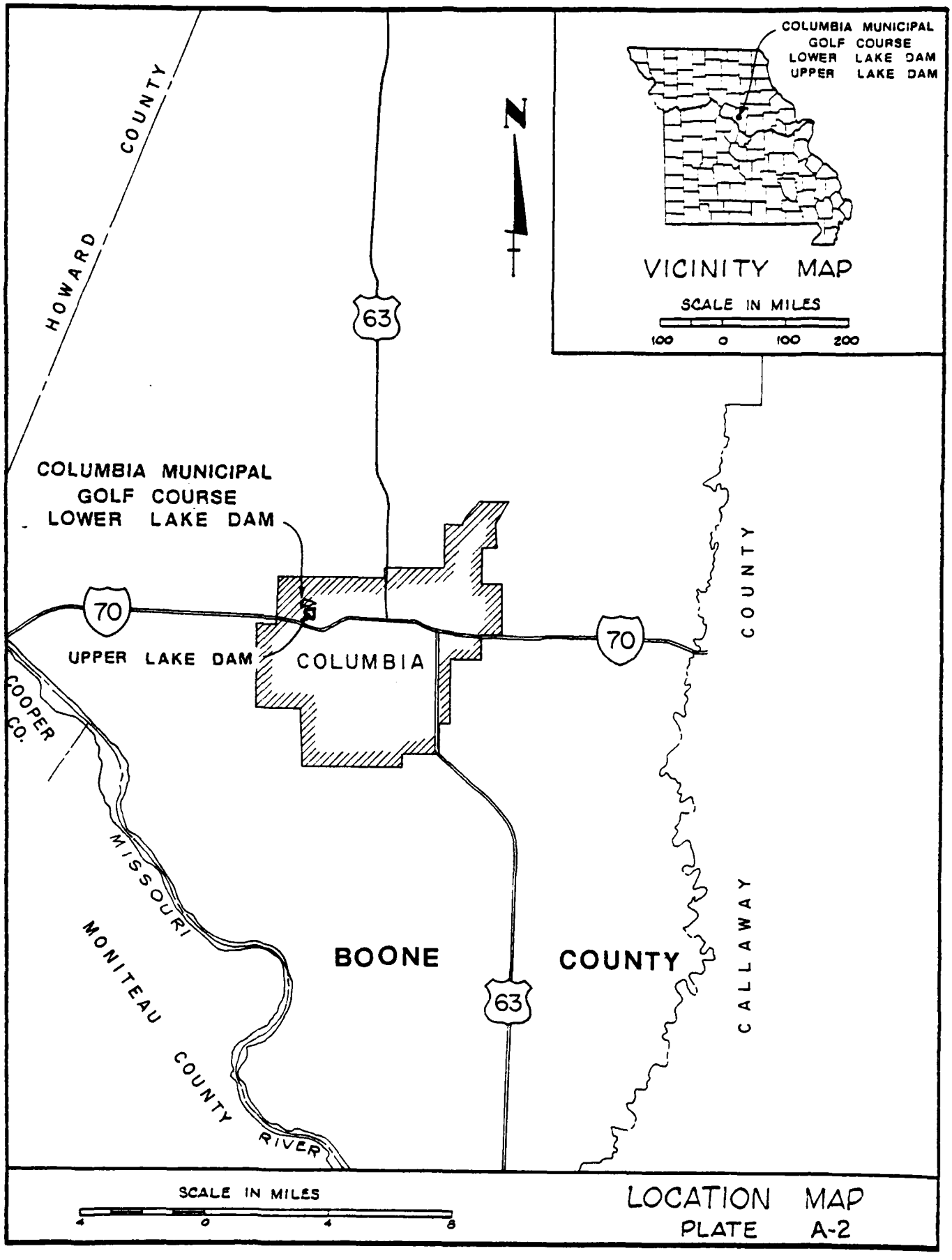
SCALE IN METERS

N

COLUMBIA MUNICIPAL
GOLF COURSE
LOWER LAKE DAM
UPPER LAKE DAM

VICINITY TOPOGRAPHY

PLATE A-1


COLUMBIA MUNICIPAL
GOLF COURSE
LOWER LAKE DAM
UPPER LAKE DAM
VICINITY MAP
SCALE IN MILES
100 0 100 200
N
HOWARD COUNTY
63
COLUMBIA MUNICIPAL
GOLF COURSE
LOWER LAKE DAM
70
UPPER LAKE DAM
COLUMBIA
70
COOPER CO.
COUNTY
MISSOURI
MONITEAU COUNTY RIVER
BOONE
COUNTY
63
CALLAWAY
SCALE IN MILES
4 0 4 8
LOCATION MAP
PLATE A-2

APPENDIX B
PHOTOGRAPHS

PHOTO. NO. 2
DOWNSTREAM SLOPE
TAKEN FROM RIGHT (NORTH)
END.

PHOTO. NO. 3
LOOKING UPSTREAM
AT CORRUGATED METAL
PIPE SPILLWAY.

PHOTO. NO. 4
LOOKING DOWNSTREAM
AT OUTLET CHANNEL.

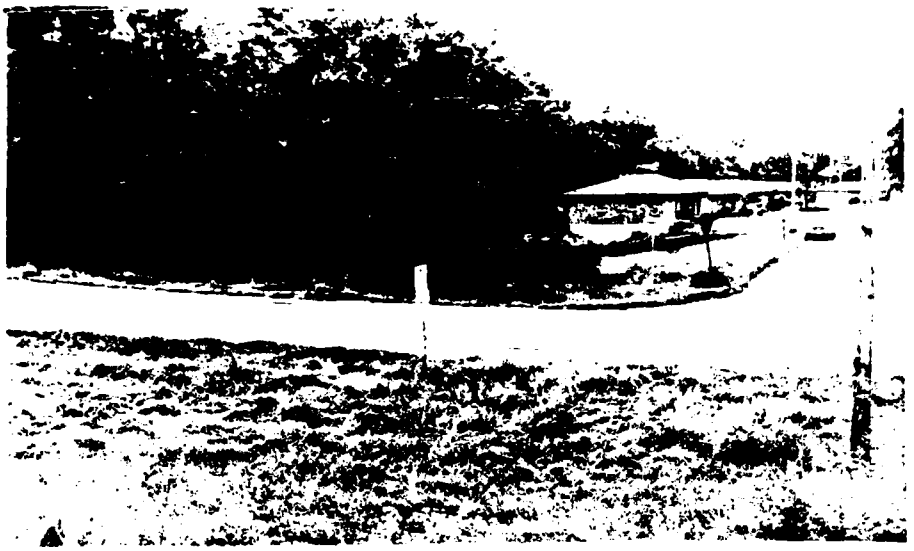


PHOTO. NO. 5
LOOKING DOWNSTREAM
FROM STA. 2+50 AT
HOUSES IN FLOOD PLAIN.

PHOTO. NO. 6
LOOKING UPSTREAM
ACROSS LAKE FROM
STATION 2+50.

PHOTO. NO. 7
UPSTREAM FACE
OF DAM TAKEN
FROM LEFT (SOUTH) END.

PLATE B-2

PHOTO. NO. 8
CREST OF DAM
TAKEN FROM RIGHT
(NORTH) END.

PHOTO. NO. 9
LOWER GOLF
COURSE LAKE
TAKEN FROM
UPPER DAM.

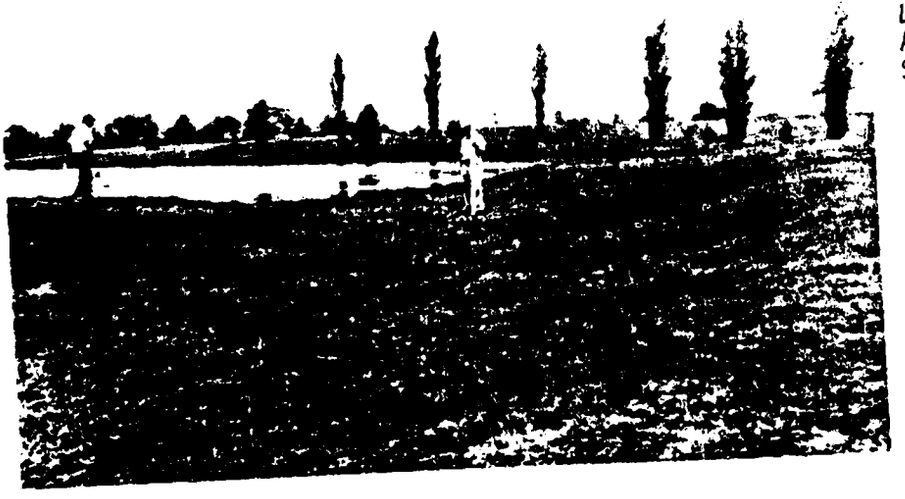
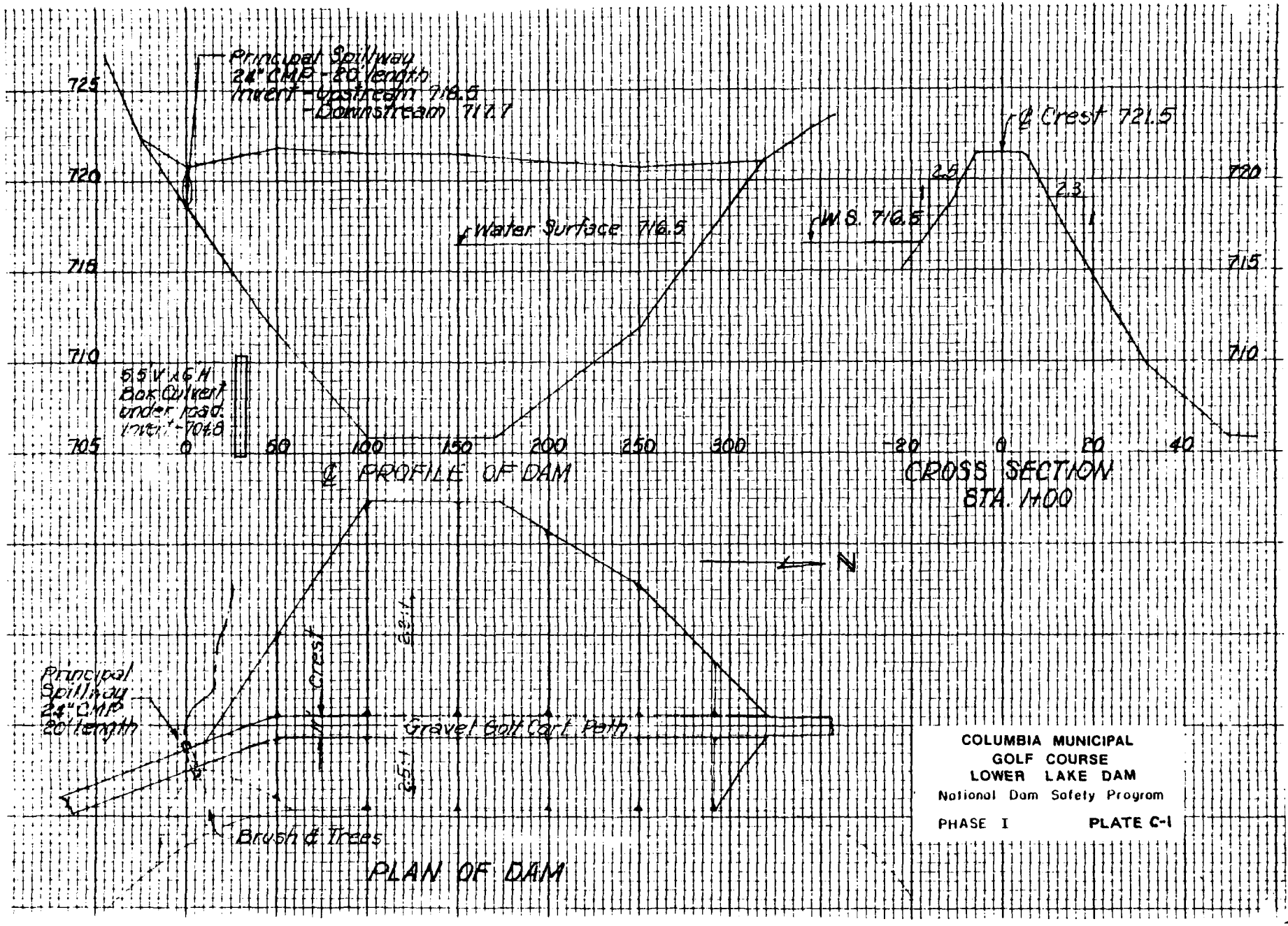


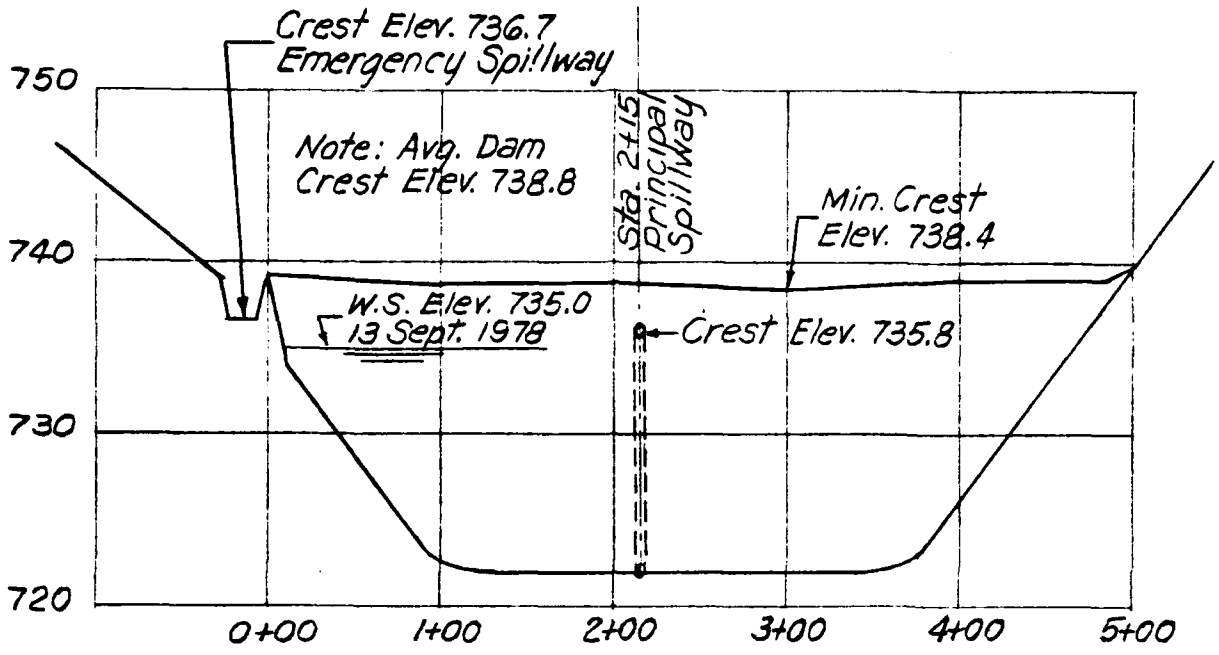
PHOTO. NO. 10
LOOKING UPSTREAM
AT UPPER DAM
SPILLWAY.

PHOTO NO. 11
UPSTREAM SLOPE OF
UPPER DAM LOOKING
FROM RIGHT TO LEFT.

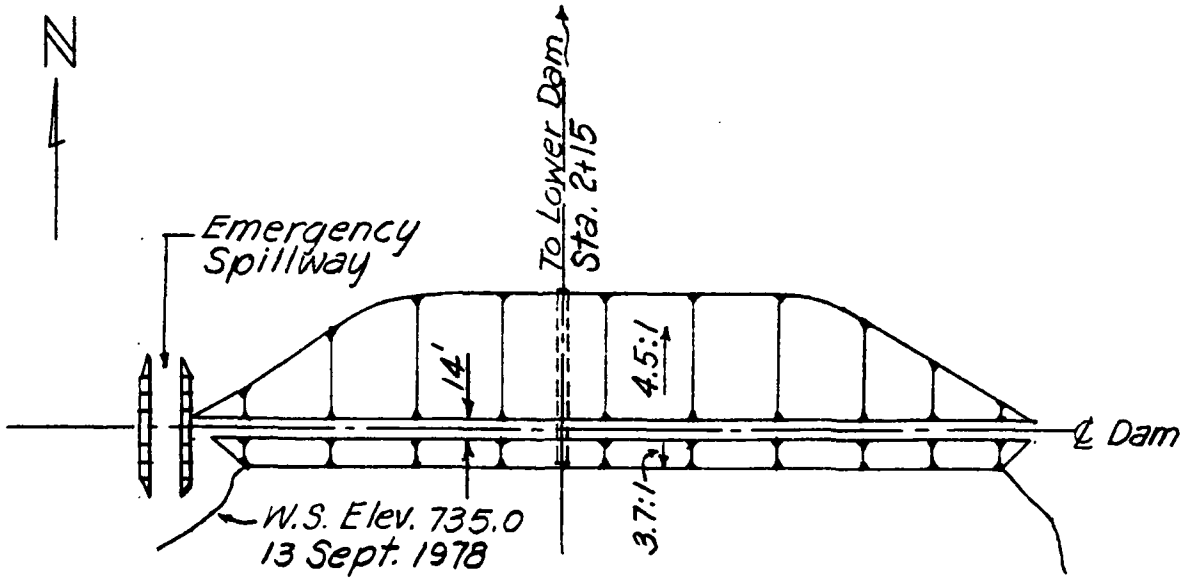
PHOTO NO. 12
DOWNSTREAM SLOPE
OF UPPER DAM LOOKING
FROM RIGHT TO LEFT.

APPENDIX C
PLANS, PROFILES AND SECTIONS


Principal Spillway
24" CMP - 20' length
Invert - Upstream 716.6
- Downstream 711.7
℄ Crest 721.5
725
720
715
710
705
2.5
1
2.3
1
℄ Water Surface 716.5
W.S. 716.5
5.5' W x 6' H
Box Culvert
under road.
Invert - 704.8
0
50
100
150
200
250
300
-20
0
20
40
℄ PROFILE OF DAM
CROSS SECTION
STA. 1+00
N
Principal
Spillway
24" CMP
20' length
℄ Crest
1:2.3
1:5.5
Gravel Golf Cart Path
Brush & Trees
PLAN OF DAM
COLUMBIA MUNICIPAL
GOLF COURSE
LOWER LAKE DAM
National Dam Safety Program
PHASE I
PLATE C-1

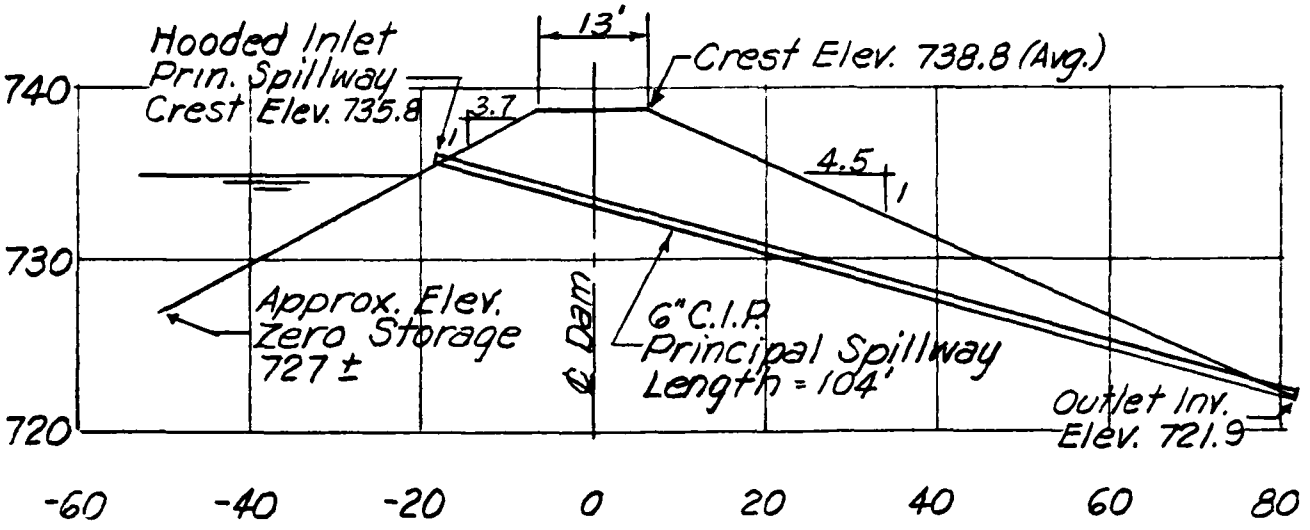


PROFILE OF DAM
Horiz. Scale: 1"=100'
Vert. Scale: 1"= 10'

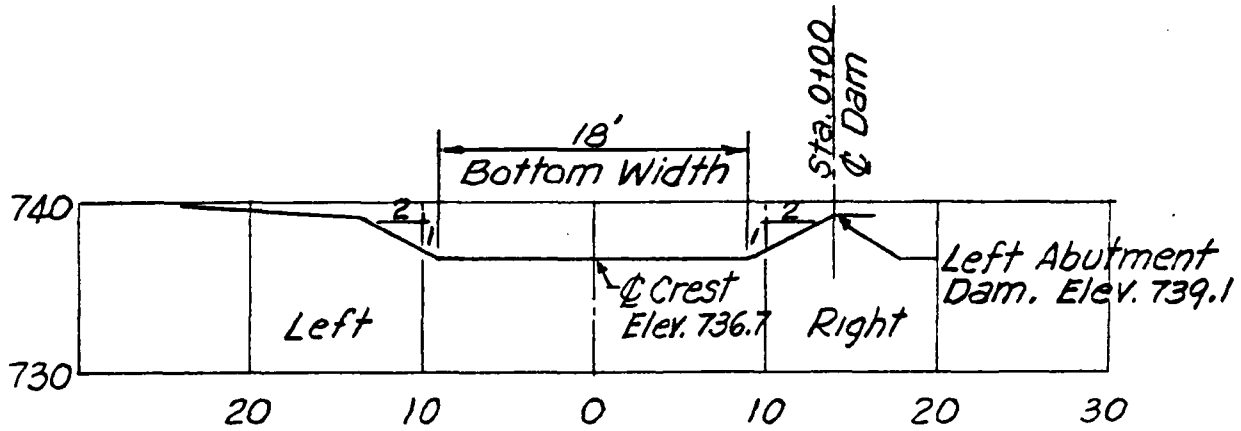


PLAN OF DAM
Scale: 1"=100'

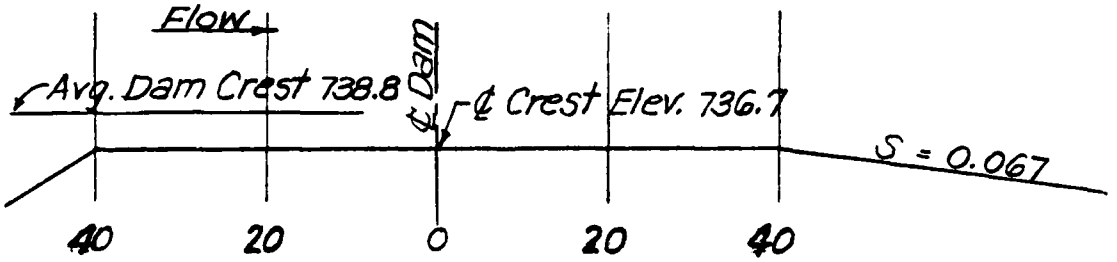
COLUMBIA MUNICIPAL GOLF COURSE UPPER LAKE DAM
NATIONAL DAM SAFETY PROGRAM
PHASE I
PLATE C-2



MAXIMUM CROSS SECTION
AT PRINCIPAL SPILLWAY
Scale: As Shown



CROSS SECTION-EMERGENCY
SPILLWAY ON ℄ DAM
Scale: As Shown



PROFILE OF EMERGENCY SPILLWAY
Scale: As Shown

COLUMBIA MUNICIPAL GOLF COURSE UPPER LAKE DAM
NATIONAL DAM SAFETY PROGRAM
PHASE I PLATE C-3

APPENDIX D
HYDROLOGIC COMPUTATIONS

HYDROLOGIC COMPUTATIONS

1. The Mockes dimensionless standard curvalinear unit hydrograph and SCS TR-20 computer program were used to develop the inflow hydrographs (See Plates D-3 and D-5). The inflow hydrograph for the 100-year flood was also generated by the TR-20 program.

   a. Six-hour, twelve-hour, and twenty-four hour 100-year rainfall for the dam location was taken from NOAA Technical Paper 40. The 24-hour index probable maximum precipitation was taken from curves of Hydrometeorological Report No. 33 and current Corps of Engineers, St. Louis District, policy and guidance for hydraulics and hydrology.

   b. Drainage area = 0.234 square miles total. This includes 0.072 square miles tributary to the upper dam alone and 0.162 square miles tributary to the lower dam alone.

   c. Times of concentration (tc) = 0.27 hour upper dam alone and 0.25 hour lower dam alone. These were computed using the Kirpich Formula.

   d. The antecedent storm conditions were heavy rainfall and low temperatures which occurred on the previous 5 days (SCS AMC III). The initial pool elevations were assumed at the crests of the principal spillways which were 735.8 M.S.L. and 718.5 M.S.L., respectively for the upper and lower dams.

   e. The total 24-hour storm duration losses for the 100-year storm were 1.36 inches. The total losses for the ½ PMF storm were 1.47 inches. The total losses for the PMF storm were 1.52 inches. These data are based on SCS runoff curve number 76.0 and antecedent moisture conditions from SCS AMC III.

   f. Average soil loss rates = 0.08 inch per hour approximately.

2. The principal spillway inlet control/full pipe flow rating for the upper dam was computed using standard formulas and criteria from the USBR publication "Design of Small Dams" for the inlet control phase of the rating up to the stage shown on the rating curve (Plate D-6). Above this stage the standard orifice flow formula $Q = 0.6\ A\sqrt{2gH}$ was used with a coefficient taken from the Corps of Engineers publication "Hydraulic Characteristics of Reservoir Outlet Works". The principal spillway inlet control/full pipe flow rating for the lower dam was computed using criteria from the American Iron and Steel Institute publication "Handbook of Steel Drainage and Highway Construction Products" for the inlet control phase and SCS criteria for the full pipe flow phase. (Plate D-4)

The emergency spillway rating for the upper dam was computed by determining the location of the control section, determining critical depths for the range of discharges, and computing water surface profiles upstream into the reservoir to establish the rating. The resulting curve is shown on Plate D-6.

The flows over both dam crests were based on the broad crested weir equation $Q = CLH^{3/2}$, where H is the head on the dam crest; L is the effective weir length and the coefficient C which varies with head was taken from the USGS publication "TWRI, Book 3, Chapter 5, Measurement of Peak Discharge at Dams by Indirect Methods". (See Plates D-4 and D-6)

The maximum tailwater against the downstream toe of the lower dam was computed by taking ½ PMF outflow from the dam; assuming negligible storage between the dam and the road crossing; taking inlet control conditions to prevail in the box culvert under the road and broad crested weir flow to occur over the road. (See Section 1.3c5 of Division I of this report)

3. Floods were routed through the reservoir using the TR-20 program, which uses the "Modified Puls" method to determine the capabilities of the spillways and dam embankment crest. The outflow from the upper dam was routed into the lower reservoir using the convex method of reach routing which is incorporated within the TR-20 program. The reservoir and channel routing interval was selected as 0.25 hour after studies with the TR-20 program showed that a further decrease of the routing interval did not change the results. The peak attenuation and time translation effect of these routings were negligible due to the short reach length between reservoirs. The storm rainfall patterns, inflow hydrographs and routed outflow hydrographs are shown on Plate D-3 (Lower Dam) and Plate D-5 (Upper Dam).

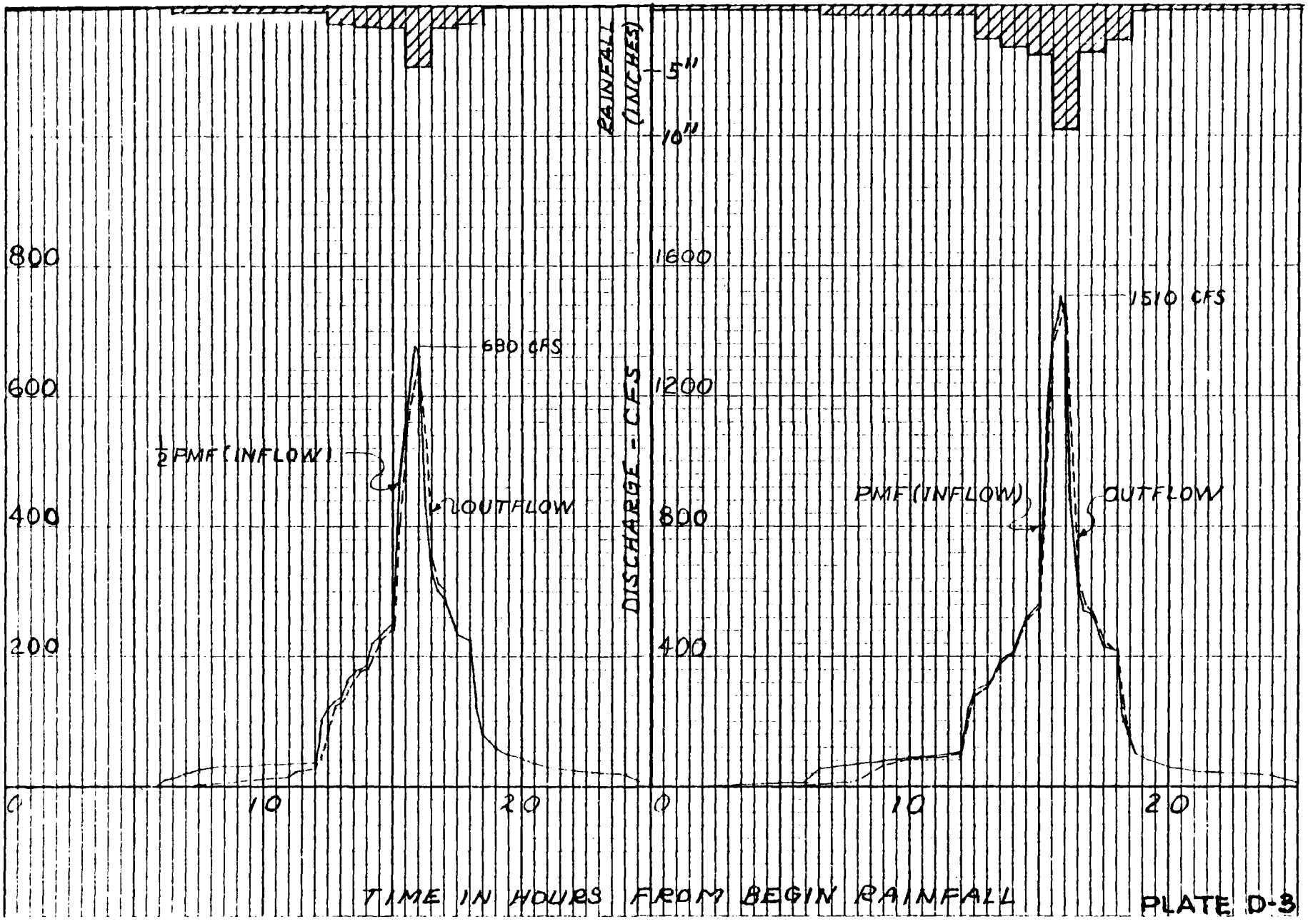
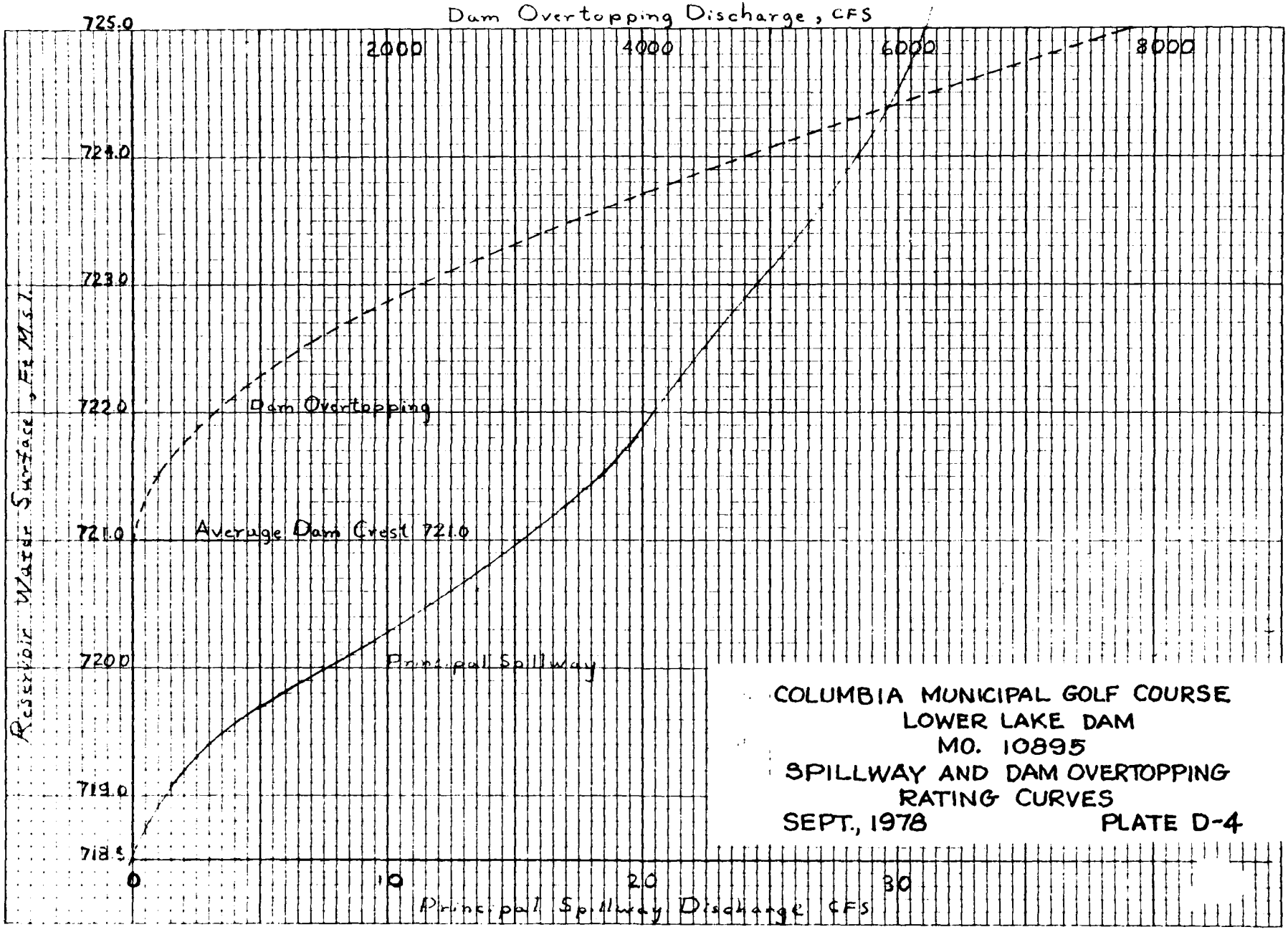


PLATE D-3



COLUMBIA MUNICIPAL GOLF COURSE
LOWER LAKE DAM
MO. 10895
SPILLWAY AND DAM OVERTOPPING
RATING CURVES
SEPT., 1978 PLATE D-4

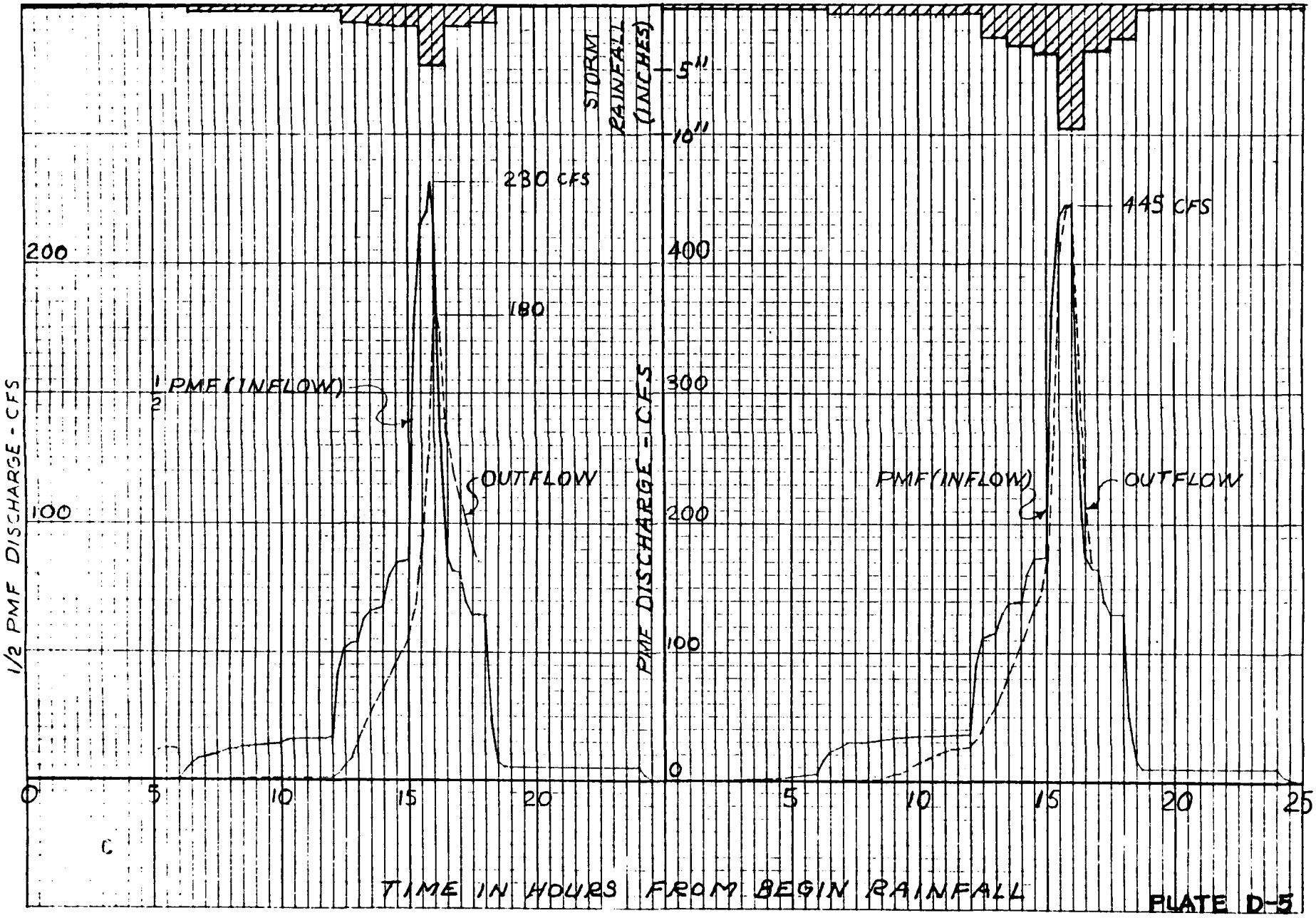
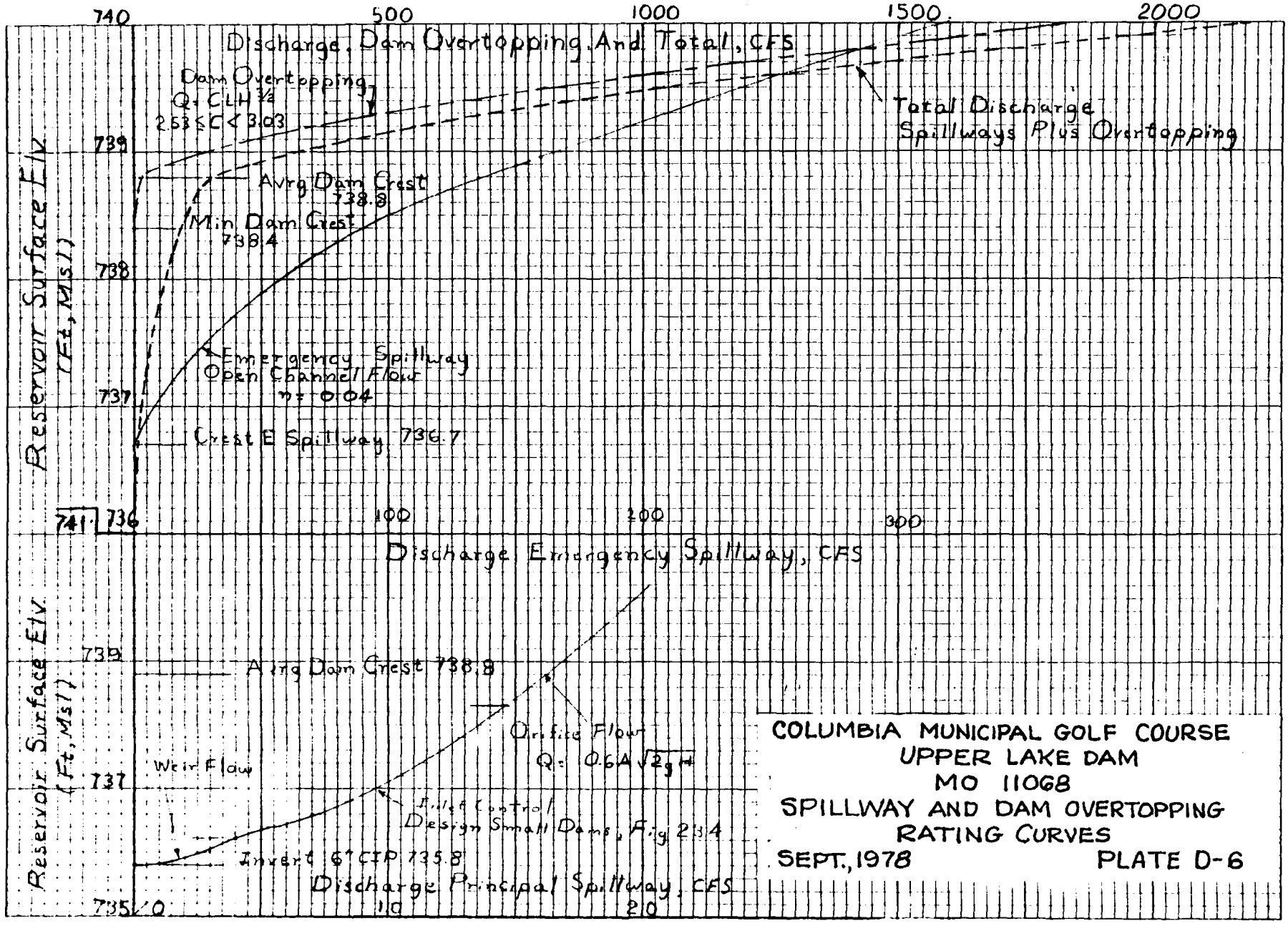

STORM RAINFALL (INCHES)
5"
10"
230 CFS
180
445 CFS
200
400
1/2 PMF (INFLOW)
OUTFLOW
PMF (INFLOW)
OUTFLOW
1/2 PMF DISCHARGE - CFS
PMF DISCHARGE - CFS
100
300
200
100
0
0
5
10
15
20
5
10
15
20
25
TIME IN HOURS FROM BEGIN RAINFALL

PLATE D-5



COLUMBIA MUNICIPAL GOLF COURSE
UPPER LAKE DAM
MO 11068
SPILLWAY AND DAM OVERTOPPING
RATING CURVES
SEPT., 1978 PLATE D-6

PLATE D-7

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HYDROLOGY PROGRAM FOR IBM 1130 - DATED JULY, 1968
EXECUTIVE CONTROL CARD    LOWER COLUMBIA MUNICIPAL GOLF COURSE MO 10895    OPERATION LIST                    TR-20 ROUTING.

LOWER COLUMBIA MUNICIPAL GOLF COURSE MO 10895

C TABLE          VELOCITY INCREMENT =  0.200                                          START INPUT DATA

 8                0.0000      0.0800      0.1600      0.2500      0.3200
 8                0.3700      0.4100      0.4500      0.4900      0.5100
 8                0.5400      0.5700      0.5900      0.6100      0.6300
 8                0.6500      0.6600      0.6700      0.6900      0.7000
 8                0.7100      0.7200      0.7300      0.7400      0.7500
 8                0.7600      0.7700      0.7700      0.7800      0.7900
 8                0.7900      0.8000      0.8100      0.8100      0.8200
 8                0.8200      0.8300      0.8300      0.8400      0.8400
 8                0.8400      0.8500      0.8500      0.8600      0.8600
 8                0.8600      0.8600      0.8700      0.8700      0.8700
 8                0.8800      0.8800      0.8800      0.8900      0.8900
 8                0.8900      0.8900      0.8900      0.8900      0.9000
 8                0.9000      0.9000      0.9000      0.9000      0.9100
 8                0.9100      0.9100      0.9100      0.9100      0.9100
 8                0.9200      0.9200      0.9200      0.9200      0.9200
 8                0.9200      0.9200      0.9200      0.9300      0.9300
 9 ENDTBL

CROSS SECTION NO.   1     DRAINAGE AREA =    1.00

                          ELEVATION   DISCHARGE    END AREA
 8                         718.5001      0.0000      0.0000
 9 ENDTBL

STRUCTURE NO.  1

                          ELEVATION   DISCHARGE     STORAGE
 8                         718.5001      0.0000      9.3299
 9 ENDTBL

STRUCTURE NO.  2

                          ELEVATION   DISCHARGE     STORAGE
 8                         735.8000      0.0000      5.0000
 9 ENDTBL

DIMENSIONLESS HYDROGRAPH - DELTA T =484.00

 8                0.0000      0.0300      0.1000      0.1900      0.3100
 8                0.4700      0.6600      0.8200      0.9300      0.9900
 8                1.0000      0.9900      0.9300      0.8600      0.7800
 8                0.6800      0.5600      0.4600      0.3900      0.3300
 8                0.2800      0.2410      0.2070      0.1740      0.1470
 8                0.1260      0.1070      0.0910      0.0770      0.0660
 8                0.0550      0.0470      0.0400      0.0340      0.0290
 8                0.0250      0.0210      0.0180      0.0150      0.0130
 8                0.0110      0.0090      0.0080      0.0070      0.0060
 8                0.0050      0.0040      0.0030      0.0020      0.0010
 8                0.0000      0.0000      0.0000      0.0000      0.0000
 9 ENDTBL

RAINFALL TABLE NO. 1      TIME INCREMENT =  0.50

 8                0.0000      0.0080      0.0170      0.0260      0.0350
 8                0.0450      0.0550      0.0650      0.0760      0.0870
 8                0.0990      0.1120      0.1250      0.1400      0.1560
 8                0.1740      0.1940      0.2190      0.2540      0.3030
 8                0.5150      0.5830      0.6240      0.6540      0.6820
 8                0.7050      0.7270      0.7480      0.7670      0.7840
 8                0.8000      0.8160      0.8300      0.8440      0.8570
 8                0.8700      0.8820      0.8930      0.9050      0.9160
 8                0.9260      0.9360      0.9460      0.9550      0.9650
 8                0.9740      0.9830      0.9920      1.0000      1.0000
 9 ENDTBL

RAINFALL TABLE NO. 2      TIME INCREMENT =  0.02

 8                0.0000      0.0100      0.0200      0.0200      0.0300
 8                0.0400      0.0500      0.0600      0.0700      0.0800
 8                0.1000      0.1100      0.1300      0.1400      0.1700
```

PLATE D-7

```
8                0.1900      0.2200      0.2700      0.3500      0.4400
8                0.5200      0.6000      0.6300      0.6400      0.6800
8                0.7000      0.7200      0.7400      0.7600      0.7700
8                0.7900      0.8000      0.8200      0.8300      0.8400
8                0.8500      0.8700      0.8800      0.8900      0.9000
8                0.9100      0.9200      0.9300      0.9400      0.9500
8                0.9567      0.9633      0.9700      0.9800      0.9900
8                1.0000      1.0000      1.0000      1.0000      1.0000
9 ENDTBL
RAINFALL TABLE NO. 3      TIME INCREMENT =  0.50
8                0.0000      0.0700      0.1400      0.2100      0.2800
8                0.3500      0.4300      0.5000      0.5800      0.6500
8                0.7300      0.8000      0.8800      1.2700      1.6600
8                2.0500      2.4400      2.8300      3.2200      3.6100
8                4.0000      4.4000      4.7900      5.1800      5.5800
8                6.8400      8.1000      9.6100     11.1200     13.0100
8               14.9000     19.6800     24.4700     26.2400     28.0000
8               29.3800     30.7700     30.8800     30.9900     31.1000
8               31.2100     31.3200     31.4300     31.5400     31.6500
8               31.7600     31.8800     32.0000     32.1100     32.1100
9 ENDTBL
RAINFALL TABLE NO. 4      TIME INCREMENT =  0.50
8                0.0000      0.0300      0.0600      0.0900      0.1200
8                0.1500      0.1800      0.2100      0.2400      0.2700
8                0.3000      0.3300      0.3600      0.4400      0.5200
8                0.6000      0.6800      0.7600      0.8500      0.9300
8                1.0200      1.1000      1.1900      1.2700      1.3600
8                1.6300      1.9000      2.2200      2.5500      2.9500
8                3.3600      4.3800      5.4100      5.7000      6.1700
8                6.4600      6.7600      6.8000      6.8500      6.8900
8                6.9400      6.9800      7.0300      7.0700      7.1200
8                7.1600      7.2100      7.2500      7.3000      7.3000
9 ENDTBL
```

PLATE D-8

STANDARD CONTROL INSTRUCTIONS

SUBRTN	XSECTN	STRCT	HYDROGRAPHS IN1	IN2	OUT	DATA NO. 1	DATA NO. 2	DATA NO. 3	OUTPUT OPTIONS PK	H	E	V	PU	SM
RUNOFF	0	2	0	0	6	0.072	76.000	0.270	1	1	0	1	0	1
RESVOR	0	2	6	0	7	735.800	0.000	0.000	1	1	1	1	0	1
REACH	1	0	7	0	5	600.000	0.280	0.000	1	1	1	1	0	1
RUNOFF	0	1	0	0	6	0.162	76.000	0.250	1	1	0	1	0	1
AUGHYD	0	1	5	6	7	0.000	0.000	0.000	1	1	0	1	0	1
SAVMOV	0	1	7	0	6	0.000	0.000	0.000	0	0	0	0	0	0
RESVOR	0	1	6	0	7	718.500	0.000	0.000	1	1	1	1	0	1
ENDATA														

END OF LISTING

PLATE D-9

4/8
16

ADDITIONS TO TABULAR DATA FOLLOW

STRUCTURE NO. 1

	Elv FT	Q CFS	V AF	
8	718.5001	0.0000	9.3300	LOWER DAM
8	718.7501	0.6000	10.2000	
8	719.0001	1.1000	11.1000	
8	719.2501	2.3000	12.0300	
8	719.5001	3.8000	13.0000	
8	719.7501	5.5000	14.0000	
8	720.0001	7.5000	15.0000	
8	720.2501	9.7000	16.1000	
8	720.5001	11.7000	17.1000	
8	720.7000	13.1000	18.0000	
8	721.0001	31.0000	19.4000	
8	721.2501	85.0000	20.6000	
8	721.5001	193.0000	21.8000	
8	721.7501	426.0000	23.1000	
8	722.0001	646.0001	24.4000	
8	722.2501	1050.0002	25.7000	
8	722.5001	1366.0002	27.1000	
8	723.0001	2279.0004	29.9000	
8	724.0001	4833.0009	36.1000	
8	725.0001	7847.0009	42.9000	

STRUCTURE NO. 2

8	735.8000	0.0000	5.0000	28.5 *
8	736.0500	0.3000	6.6000	30.1
8	736.3000	0.4000	8.3000	31.8
8	736.5500	0.7000	10.0000	33.5
8	736.7000	0.8000	11.1000	34.6
8	737.0001	9.1000	13.3000	36.8
8	738.0001	58.5000	21.0000	44.5
8	738.4000	90.5000	24.2000	47.7
8	738.8000	145.0000	27.6000	51.1
8	739.0001	307.0000	29.4000	52.9
8	739.2501	616.0001	31.6000	55.1
8	739.5001	1040.0002	33.8000	57.3
8	739.7501	1566.0002	36.1000	59.6
8	740.0001	2180.0004	38.5000	62.0
8	740.5001	3830.0004	43.3000	
8	741.0001	5330.0009	48.3000	
8	741.5001	6690.0009	53.5000	
8	742.0001	7910.0009	58.8000	
8	742.5001	8990.0019	64.4000	
8	743.5001	10700.0019	75.9000	

Note **Upper Dam**
These Storage Values reflect a modification per COE adjustment for additional dead storage below the principal spillway invert & are used in the report. The incremental ΔV's values above 735.8 are unchanged.
Kim 12/19/78

END INPUT

EXECUTIVE CONTROL CARD OPERATION INCREM; MAIN TIME INCREMENT= 0.25
EXECUTIVE CONTROL CARD OPERATION COMPUT; FROM XSECTN/STRUCT 0/ 2 TO XSECTN/STRUCT 0/ 1
STARTING TIME= 0.00 RAIN DEPTH= 1.00 RAIN DURATION= 1.00 RAIN TABLE NO.= 3 SOIL CONDITION= 3
ALTERNATE NO.= 1 STORM NO.= 1

SUBROUTINE RUNOFF STRUCTURE 2
AREA= 0.07 INPUT RUNOFF CURVE= 76.0 TIME OF CONCENTRATION= 0.27
COMPUTED CURVE NO. = 88.6

PMF

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
5.05	3.305	(RUNOFF)
10.50	35.026	(RUNOFF)
15.86	445.177	(RUNOFF)
23.67	11.234	(RUNOFF)

HYDROGRAPH, TZERO= 2.75 DELTA T= 0.25 DRAINAGE AREA= 0.07

Inflow

TIME											
2.75	DISCHG	0.00	1.36	1.53	1.72	2.13	2.46	2.47	2.56	2.99	3.09
5.25	DISCHG	3.18	3.20	3.64	4.03	15.72	22.52	25.13	26.84	28.17	29.23
7.75	DISCHG	30.10	30.82	31.43	31.93	32.37	32.74	33.07	33.35	33.60	33.81
10.25	DISCHG	34.61	35.03	34.61	34.51	34.60	34.72	35.43	36.16	98.77	111.29
12.75	DISCHG	114.21	114.92	130.86	137.70	138.75	134.28	163.24	173.39	174.70	175.47
15.25	DISCHG	358.62	434.76	444.03	443.64	253.08	174.17	164.78	163.61	139.66	121.65
17.75	DISCHG	129.18	129.05	47.80	14.22	10.54	10.24	10.24	10.24	10.24	10.24
20.25	DISCHG	10.24	10.24	10.24	10.24	10.24	10.24	10.24	10.24	10.24	10.24
22.75	DISCHG	10.07	11.14	11.17	11.16	10.53	10.20	2.33	0.34	0.02	0.00

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 30.5000 CFS-HRS= 1427.29 ACRE-FT= 117.79

SUBROUTINE RESVOR STRUCTURE 2

SURFACE ELEVATION= 735.80

PEAK TIMES 15.86 | PEAK DISCHARGES 440.432 | PEAK ELEVATIONS 739.11

HYDROGRAPH, TZERO= 2.75 DELTA T= 0.25 DRAINAGE AREA= 0.07

TIME											
2.75	DISCHG	0.00	0.00	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07
2.75	ELEV	735.80	735.80	735.80	735.81	735.81	735.82	735.83	735.84	735.85	735.86
5.25	DISCHG	0.08	0.09	0.10	0.12	0.16	0.23	0.30	0.35	0.37	0.42
5.25	ELEV	735.87	735.88	735.89	735.90	735.93	735.99	736.07	736.14	736.23	736.31
7.75	DISCHG	0.52	0.63	0.72	0.78	2.44	4.70	6.81	8.79	11.06	14.46
7.75	ELEV	736.40	736.49	736.58	736.67	736.75	736.84	736.91	736.98	737.05	737.10
10.25	DISCHG	16.87	19.10	21.05	22.73	24.20	25.50	26.69	27.82	32.13	40.57
10.25	ELEV	737.15	737.20	737.24	737.27	737.30	737.33	737.35	737.37	737.46	737.63
12.75	DISCHG	49.55	57.64	69.41	81.56	93.04	106.10	118.35	132.96	144.64	173.12
12.75	ELEV	737.81	737.98	738.13	738.28	738.41	738.51	738.60	738.71	738.79	738.95
15.25	DISCHG	263.63	411.25	444.57	443.70	330.82	213.45	171.07	164.45	152.10	142.15
15.25	ELEV	738.94	739.08	739.11	739.11	739.01	738.88	738.83	738.80	738.80	738.77
17.75	DISCHG	138.51	135.64	122.37	96.41	78.66	65.87	56.46	50.75	45.69	41.29
17.75	ELEV	738.75	738.73	738.63	738.44	738.25	738.09	737.95	737.84	737.74	737.65
20.25	DISCHG	37.43	34.05	31.09	28.49	26.22	24.24	22.50	20.97	19.64	18.47
20.25	ELEV	737.57	737.50	737.44	737.39	737.34	737.30	737.27	737.24	737.21	737.18
22.75	DISCHG	17.49	16.68	15.99	15.39	14.83	14.27	13.33	11.90	10.44	9.14
22.75	ELEV	737.16	737.15	737.13	737.12	737.11	737.10	737.08	737.05	737.02	737.00
25.25	DISCHG	8.44	7.80	7.22	6.68	6.18	5.71	5.28	4.89	4.52	4.18
25.25	ELEV	736.97	736.95	736.93	736.91	736.89	736.87	736.86	736.84	736.83	736.82

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 28.8337 CFS-HRS= 1345.39 ACRE-FT= 111.18

SUBROUTINE REACH CROSS SECTION 1
LENGTH= 600.00 INPUT COEFFICIENT= 0.2800 INPUT ROUTINGS= 0.00

AVERAGE WATER VELOCITY= 0.800 ROUTING COEFF= 0.2800 MODIFIED COEFFICIENT= 0.7553

NULL STRUCTURE...NO ELEVATIONS GIVEN

PEAK TIMES 15.94 | PEAK DISCHARGES 438.368 | PEAK ELEVATIONS (NULL)

HYDROGRAPH, TZERO= 2.75 DELTA T= 0.25 DRAINAGE AREA= 0.07

TIME											
2.75	DISCHG	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.04	0.05	0.06
5.25	DISCHG	0.07	0.08	0.10	0.11	0.14	0.19	0.26	0.31	0.35	0.39
7.75	DISCHG	0.47	0.57	0.67	0.74	1.73	3.57	5.65	7.68	10.18	13.09
10.25	DISCHG	15.46	17.81	19.92	21.75	23.34	24.74	26.01	27.18	30.16	36.54
12.75	DISCHG	44.78	53.06	63.33	74.96	86.59	99.02	111.80	125.31	137.85	159.47
15.25	DISCHG	222.19	338.98	412.86	436.31	376.52	274.04	203.73	175.23	159.93	148.24
17.75	DISCHG	141.53	137.71	128.50	108.44	89.17	73.83	62.38	54.59	48.76	45.69
20.25	DISCHG	39.69	36.02	32.82	30.01	27.55	25.40	23.51	21.86	20.42	19.15
22.75	DISCHG	18.07	17.16	16.40	15.74	15.15	14.59	13.81	12.62	11.23	9.66
25.25	DISCHG	8.92	8.19	7.56	6.99	6.46	5.98	5.53	5.11	4.73	4.75

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 28.7737 CFS-HRS= 1342.58 ACRE-FT= 110.95

SUBROUTINE RUNOFF STRUCTURE 1
AREA= 0.16 INPUT RUNOFF CURVE= 76.0 TIME OF CONCENTRATION= 0.25
COMPUTED CURVE NO. = 88.6

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
4.11	5.648	(RUNOFF)
5.04	7.427	(RUNOFF)
10.48	78.555	(RUNOFF)
15.84	997.351	(RUNOFF)
17.87	314.492	(RUNOFF)
23.33	25.068	(RUNOFF)

HYDROGRAPH, TZERO= 2.25 DELTA T= 0.25 DRAINAGE AREA= 0.16

TIME											
2.25	DISCHG	0.00	1.36	2.28	3.12	3.46	3.89	4.85	5.57	5.53	5.76

4.75	DISCHG	6.78	7.41	7.11	7.19	8.24	8.83	37.44	51.20	56.66	58.38
7.25	DISCHG	63.30	65.65	67.57	69.17	70.50	71.63	72.59	73.42	74.14	74.77
9.75	DISCHG	75.31	75.81	77.67	78.54	77.48	77.32	77.55	77.81	79.50	80.32
12.25	DISCHG	209.10	251.23	256.26	257.71	295.94	304.13	310.96	312.05	569.71	589.56
14.75	DISCHG	391.60	392.17	837.61	980.25	996.04	993.98	585.83	583.46	568.07	566.55
17.25	DISCHG	308.89	289.67	289.44	289.81	91.99	29.10	23.19	22.94	22.94	22.94
19.75	DISCHG	22.94	22.94	22.94	22.94	22.94	22.94	25.04	22.94	22.94	22.94
22.25	DISCHG	22.94	22.94	24.49	24.98	25.03	25.02	23.49	22.98	5.95	0.52
24.75	DISCHG	0.02	0.00								

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 30.5963 CFS-HRS= 5190.84 ACRE-FT= 264.55

SUBROUTINE ADDHYD STRUCTURE 1
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

DUE TO STORAGE OVERFLOW, THE SUM OF HYDROGRAPHS 6 AND 5 WAS TRUNCATED HERE TO 100 VALUES.

PEAK TIMES: 4.11, 5.04, 15.08, 22.75
PEAK DISCHARGES: 5.679, 7.495, 1487.937, 42.530
PEAK ELEVATIONS: 719.77, 719.99, 722.56, 721.05

INFLOW PMF STORM LOWER DAM

TIME		HYDROGRAPH, TZERO= 2.25				DELTA T= 0.25			DRAINAGE AREA= 0.23		
2.25	DISCHG	0.00	1.36	2.28	3.12	3.46	3.90	4.87	5.59	5.57	5.50
4.75	DISCHG	6.83	7.47	7.18	7.28	8.34	8.95	37.58	51.40	56.93	60.69
7.25	DISCHG	63.65	66.05	68.05	69.74	71.17	72.38	74.33	77.00	79.79	82.45
9.75	DISCHG	85.50	88.71	93.14	96.36	97.40	94.07	100.90	102.56	105.51	107.41
12.25	DISCHG	239.27	287.77	301.05	310.77	359.28	384.09	397.56	411.08	481.51	514.03
14.75	DISCHG	529.45	551.64	1059.31	1319.23	1408.90	1430.29	911.96	657.50	571.81	541.76
17.25	DISCHG	468.83	437.92	430.97	427.52	220.49	137.94	112.37	96.77	85.32	77.54
19.75	DISCHG	71.71	66.84	62.63	58.97	55.76	52.96	50.50	48.35	46.46	44.81
22.25	DISCHG	43.37	42.10	42.56	42.15	41.43	40.77	38.65	37.57	19.74	13.15
24.75	DISCHG	11.25	9.88	8.92	8.19	7.56	6.99	6.46	5.98	5.53	5.11

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 30.0179 CFS-HRS= 4559.01 ACRE-FT= 37?.10

SUBROUTINE SAVMOV STRUCTURE 1
INPUT HYDROGRAPH= 7 OUTPUT HYDROGRAPH= 6

SUBROUTINE RESVOR STRUCTURE 1
SURFACE ELEVATION= 718.50

OUT FLOW PMF STORM LOWER DAM

PEAK TIMES: 15.90
PEAK DISCHARGES: 1468.607
PEAK ELEVATIONS: 722.55 **

TIME		HYDROGRAPH, TZERO= 2.25				DELTA T= 0.25			DRAINAGE AREA= 0.23		
2.25	DISCHG	0.00	0.00	0.03	0.07	0.11	0.16	0.22	0.29	0.37	0.44
2.25	ELEV	718.50	718.50	718.51	718.53	718.54	718.57	718.59	718.62	718.65	718.68
4.75	DISCHG	0.53	0.62	0.69	0.77	0.85	0.94	1.52	2.48	4.14	6.12
4.75	ELEV	718.72	718.76	718.79	718.83	718.87	718.92	719.04	719.20	719.55	719.82
7.25	DISCHG	8.39	10.67	12.66	23.16	39.70	60.06	74.50	73.05	76.44	79.41
7.25	ELEV	720.10	720.37	720.64	720.86	721.04	721.13	721.17	721.19	721.21	721.22
9.75	DISCHG	82.31	85.54	90.72	94.60	96.80	93.18	99.02	101.67	103.95	106.37
9.75	ELEV	721.23	721.25	721.26	721.27	721.27	721.28	721.28	721.28	721.29	721.29
12.25	DISCHG	170.90	203.50	297.67	308.37	342.98	380.26	395.38	407.41	457.26	509.21
12.25	ELEV	721.44	721.59	721.61	721.62	721.66	721.70	721.71	721.73	721.78	721.84
14.75	DISCHG	525.57	544.63	922.66	1306.65	1389.16	1436.10	1098.43	692.25	607.15	593.02
14.75	ELEV	721.86	721.88	722.17	722.45	722.51	722.53	722.35	721.99	721.95	721.93
17.25	DISCHG	495.02	442.03	432.38	428.40	292.88	157.59	126.55	105.36	91.57	82.23
17.25	ELEV	721.82	721.76	721.75	721.75	721.60	721.41	721.34	721.29	721.26	721.24
19.75	DISCHG	77.64	72.33	67.51	64.25	53.52	50.24	53.38	50.67	48.67	46.74
19.75	ELEV	721.21	721.19	721.16	721.14	721.13	721.11	721.10	721.09	721.08	721.07
22.25	DISCHG	45.06	43.58	42.79	42.41	42.05	41.45	40.54	39.75	38.91	37.73
22.25	ELEV	721.06	721.05	721.05	721.05	721.05	721.04	721.04	721.03	721.01	720.99
24.75	DISCHG	24.15	20.99	18.29	16.01	14.11	13.03	13.32	12.64	12.53	12.17
24.75	ELEV	720.88	720.83	720.78	720.74	720.71	720.68	720.66	720.63	720.59	720.56

PLATE D-12

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 29.3552 CFS-HPS= 4436.81 ACRE-FT= 366.82

ENDCMP 1

PLATE D-13

EXECUTIVE CONTROL CARD OPERATION COMPUT. FROM XSECTN/STRUCT 0/ 2 TO XSECTN/STRUCT 0/ 1
STARTING TIME= 0.00 RAIN DEPTH= 0.50 RAIN DURATION= 1.00 RAIN TABLE NO.= 3 SOIL CONDITION= 3
ALTERNATE NO.= 2 STORM NO.= 1

SUBROUTINE RUNOFF STRUCTURE 2
AREA= 0.07 INPUT RUNOFF CURVE= 76.0 TIME OF CONCENTRATION= 0.27
COMPUTED CURVE NO. = 88.6

PEAK TIMES: 10.50, 15.87, 23.37
PEAK DISCHARGES: 15.529, 231.824, 5.601
PEAK ELEVATIONS: (RUNOFF), (RUNOFF), (RUNOFF)

TIME		HYDROGRAPH, TZERO= 6.00				DELTA T= 0.25			DRAINAGE AREA= 0.07		
6.00	DISCHG	0.00	5.64	6.00	7.45	8.60	9.58	10.41	11.12	11.75	12.29
8.50	DISCHG	12.77	13.19	13.56	13.90	14.20	14.46	14.71	15.19	15.50	15.94
11.00	DISCHG	15.49	15.63	15.77	16.18	16.60	41.07	51.98	53.81	54.56	62.55
13.50	DISCHG	66.18	67.00	67.54	79.45	84.67	85.54	86.12	176.56	214.66	219.79
16.00	DISCHG	220.01	126.63	86.52	81.39	81.34	64.45	64.48	64.27	64.22	25.79
18.50	DISCHG	7.08	5.24	5.09	5.09	5.09	5.09	5.09	5.09	5.09	5.09
21.00	DISCHG	5.09	5.09	5.09	5.09	5.09	5.09	5.10	5.41	5.54	5.56
23.50	DISCHG	5.56	5.24	5.08	1.60	0.17	0.01	0.00			

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 14.5647 CFS-HRS= 679.59 ACRE-FT= 96.16

SUBROUTINE RESVOR STRUCTURE 2
SURFACE ELEVATION= 735.80

PEAK TIMES: 16.11
PEAK DISCHARGES: 179.573
PEAK ELEVATIONS: 738.84

TIME		HYDROGRAPH, TZERO= 6.00				DELTA T= 0.25			DRAINAGE AREA= 0.07		
6.00	DISCHG	0.00	0.00	0.02	0.05	0.08	0.11	0.15	0.19	0.23	0.28
6.00	ELEV	735.80	735.80	735.82	735.84	735.86	735.89	735.92	735.96	736.00	736.05
8.50	DISCHG	0.31	0.32	0.34	0.35	0.37	0.39	0.42	0.47	0.53	0.56
8.50	ELEV	736.07	736.11	736.15	736.19	736.23	736.27	736.32	736.36	736.41	736.45
11.00	DISCHG	0.64	0.69	0.72	0.75	0.78	2.26	5.58	9.16	14.75	20.30
11.00	ELEV	736.50	736.54	736.58	736.63	736.67	736.75	736.87	737.00	737.11	737.22
13.50	DISCHG	25.69	30.77	35.31	40.06	45.28	50.23	54.66	67.07	91.48	127.21
13.50	ELEV	737.33	737.43	737.53	737.62	737.73	737.83	737.92	738.10	738.40	738.80
16.00	DISCHG	174.00	172.86	134.24	120.02	109.11	99.53	90.35	85.49	81.51	79.49
16.00	ELEV	738.83	738.83	738.72	738.61	738.53	738.46	738.39	738.33	738.28	738.19
18.50	DISCHG	63.43	54.65	48.50	43.10	38.38	34.24	30.62	27.44	24.66	22.23
18.50	ELEV	738.06	737.92	737.79	737.68	737.59	737.50	737.43	737.37	737.31	737.26
21.00	DISCHG	20.10	18.24	16.60	15.17	13.92	12.82	11.86	11.04	10.35	9.75
21.00	ELEV	737.22	737.18	737.15	737.12	737.09	737.07	737.05	737.03	737.02	737.01
23.50	DISCHG	9.23	8.89	8.61	8.21	7.66	7.10	6.56	6.07	5.61	5.19
23.50	ELEV	737.00	736.99	736.98	736.96	736.94	736.92	736.90	736.89	736.87	736.85
26.00	DISCHG	4.80	4.44	4.11	3.80	3.51	3.25	3.01	2.78	2.57	2.38
26.00	ELEV	736.84	736.83	736.81	736.80	736.79	736.78	736.77	736.77	736.76	736.75
28.50	DISCHG	2.20	2.03	1.88	1.74	1.61	1.49	1.38	1.27	1.18	1.09
28.50	ELEV	736.75	736.74	736.73	736.73	736.72	736.72	736.72	736.71	736.71	736.71

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 12.9748 CFS-HRS= 605.40 ACRE-FT= 90.03

SUBROUTINE REACH CROSS SECTION 1
LENGTH= 600.00 INPUT COEFFICIENT= 0.2800 INPUT ROUTINGS= 0.00
AVERAGE WATER VELOCITY= 0.800 ROUTING COEFF= 0.2500 MODIFIED COEFFICIENT= 0.7553
NULL STRUCTURE...NO ELEVATIONS GIVEN

PEAK TIMES: 16.24
PEAK DISCHARGES: 167.460
PEAK ELEVATIONS: (NULL)

TIME		HYDROGRAPH, TZERO= 6.00	DELTA T= 0.25	DRAINAGE AREA= 0.07

PLATE D-14

6.00	DISCHG	0.00	0.00	0.01	0.03	0.06	0.09	0.13	0.17	0.21	0.26
8.50	DISCHG	0.29	0.31	0.43	0.54	0.66	0.76	1.64	3.40	5.50	8.55
11.00	DISCHG	0.61	0.66	0.70	0.73	0.76	1.64	4.03	7.27	11.94	17.22
13.50	DISCHG	22.65	27.49	32.70	37.42	42.44	47.45	52.11	61.22	79.78	109.51
16.00	DISCHG	149.93	167.45	149.17	129.66	116.06	101.26	95.02	88.82	84.00	78.05
18.50	DISCHG	68.95	59.70	52.32	46.31	41.15	36.66	32.79	29.40	26.29	23.65
21.00	DISCHG	21.35	19.33	17.56	16.01	14.65	13.46	12.42	11.52	10.76	10.10
23.50	DISCHG	9.54	9.11	8.76	8.42	7.95	7.40	6.86	6.35	5.88	5.43
26.00	DISCHG	5.03	4.65	4.30	3.98	3.68	3.40	3.15	2.91	2.69	2.49
28.50	DISCHG	2.30	2.13	1.97	1.82	1.68	1.56	1.44	1.33	1.23	1.23

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 12.9685 CFS-HRS= 6[illegible].11 ACRE-FT= 30.00

SUBROUTINE RUNOFF STRUCTURE 1
AREA= 0.16 INPUT RUNOFF CURVE= 76.0 TIME OF CONCENTRATION= 0.25
COMPUTED CURVE NO. = 88.6

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
10.56	34.816	(RUNOFF)
15.87	494.202	(RUNOFF)
17.87	156.301	(RUNOFF)
23.32	12.455	(RUNOFF)

HYDROGRAPH, TZERO= 4.75 DELTA T= 0.25 DRAINAGE AREA= 0.16

TIME											
4.75	DISCHG	0.00	1.07	1.15	1.27	1.57	1.80	8.73	13.72	16.89	19.44
7.25	DISCHG	21.60	23.44	25.03	26.41	27.62	28.68	29.62	30.45	31.19	31.85
9.75	DISCHG	32.45	33.00	34.12	34.79	34.57	34.73	35.05	35.36	35.32	35.02
12.25	DISCHG	96.78	117.40	120.82	122.40	141.49	146.63	150.23	151.36	179.98	190.16
14.75	DISCHG	191.79	192.51	412.43	484.12	493.12	493.00	265.62	190.50	162.93	162.24
17.25	DISCHG	153.62	144.09	144.01	144.23	45.76	14.48	11.54	11.42	11.42	11.42
19.75	DISCHG	11.42	11.42	11.42	11.42	11.42	11.42	11.42	11.42	11.42	11.42
22.25	DISCHG	11.42	11.42	12.19	12.44	12.46	12.45	11.70	11.44	2.95	0.26
24.75	DISCHG	0.01	0.00								

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 14.5985 CFS-HRS= 1526.27 ACRE-FT= 126.13

SUBROUTINE ADDHYD STRUCTURE 1
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

DUE TO STORAGE OVERFLOW, THE SUM OF HYDROGRAPHS 6 AND 5 WAS TRUNCATED HERE TO 100 VALUES.

INFLOW ½ PMF STORM LOWER DAM

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
10.57	35.534	721.02
15.91	657.550	722.00

HYDROGRAPH, TZERO= 4.75 DELTA T= 0.25 DRAINAGE AREA= 0.25

TIME											
4.75	DISCHG	0.00	1.07	1.15	1.27	1.57	1.80	8.73	13.74	16.93	19.50
7.25	DISCHG	21.69	23.58	25.21	26.63	27.88	28.97	29.93	30.76	31.54	32.22
9.75	DISCHG	32.83	33.40	34.57	35.29	35.13	35.34	35.72	36.07	37.06	37.59
12.25	DISCHG	98.41	121.43	128.10	134.35	158.71	171.29	178.13	184.06	217.41	232.00
14.75	DISCHG	239.24	244.65	473.66	563.90	602.43	642.93	453.08	339.67	312.59	298.38
17.25	DISCHG	258.88	239.71	232.04	228.23	123.84	83.44	71.24	63.74	57.73	52.57
19.75	DISCHG	48.08	44.16	40.72	37.71	35.08	32.77	30.75	28.98	27.43	26.06
22.25	DISCHG	24.89	23.85	23.72	23.20	22.57	21.99	20.81	20.22	11.58	8.21
24.75	DISCHG	7.41	6.86	6.35	5.88	5.43	5.03	4.65	4.30	3.98	3.68
27.25	DISCHG	3.40	3.15	2.91	2.69	2.49	2.30	2.13	1.97	1.82	1.68

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 14.0829 CFS-HRS= 2129.40 ACRE-FT= 175.78

SUBROUTINE SAVMOV STRUCTURE 1
INPUT HYDROGRAPH= 7 OUTPUT HYDROGRAPH= 6

SUBROUTINE RESVOR STRUCTURE 1
SURFACE ELEVATION= 718.50

OUTFLOW ½ PMF STORM LOWER DAM

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
15.93	636.167	721.90

HYDROGRAPH, TZERO= 4.75 DELTA T= 0.25 DRAINAGE AREA= 0.25

TIME											
4.75	DISCHG	0.00	0.00	0.02	0.04	0.05	0.08	0.15	0.31	0.52	0.74
4.75	ELEV	718.50	718.50	718.50	718.51	718.52	718.53	718.56	718.63	718.71	718.82
7.25	DISCHG	0.96	1.36	1.97	2.66	3.43	4.26	5.13	6.09	7.10	8.10
7.25	ELEV	718.93	719.05	719.16	719.31	719.43	719.56	719.69	719.82	719.95	720.06
9.75	DISCHG	9.09	10.07	11.03	11.93	12.67	15.23	19.97	23.68	20.69	20.17

PLATE D-15

9.75	ELEV	720.18	720.29	720.41	720.53	720.63	720.73	720.81	720.87	720.92	720.96
12.25	DISCHG	50.68	89.98	123.50	130.94	145.96	164.31	174.33	180.85	202.45	231.74
12.25	ELEV	721.09	721.26	721.33	721.35	721.39	721.43	721.45	721.47	721.51	721.54
14.75	DISCHG	237.17	243.36	393.72	553.49	591.25	631.24	612.62	350.47	318.86	301.44
14.75	ELEV	721.54	721.55	721.71	721.99	721.93	721.98	721.84	721.66	721.63	721.61
17.25	DISCHG	271.77	242.59	234.39	229.38	160.59	106.00	80.64	72.30	64.96	58.74
17.25	ELEV	721.58	721.55	721.54	721.53	721.44	721.29	721.22	721.19	721.15	721.12
19.75	DISCHG	53.40	48.78	44.75	41.24	38.16	35.47	33.12	31.05	30.35	29.54
19.75	ELEV	721.10	721.08	721.06	721.04	721.03	721.02	721.00	721.00	720.98	720.97
22.25	DISCHG	28.57	27.59	26.70	25.94	25.23	24.54	23.81	23.04	21.35	18.65
22.25	ELEV	720.95	720.94	720.92	720.91	720.90	720.89	720.87	720.86	720.83	720.79
24.75	DISCHG	16.12	14.03	12.99	12.77	12.54	12.31	12.08	11.84	11.56	11.25
24.75	ELEV	720.75	720.71	720.66	720.65	720.62	720.58	720.55	720.52	720.48	720.44
27.25	DISCHG	10.94	10.63	10.32	10.02	9.72	9.42	9.13	8.84	8.56	8.28
27.25	ELEV	720.40	720.36	720.32	720.29	720.25	720.21	720.18	720.15	720.12	720.08

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 13.5937 CFS-HRS= 2055.50 ACRE-FT= 169.66

ENDCMP 1

PLATE D-16

EXECUTIVE CONTROL CARD 2 OPERATION COMPUT. FROM XSECTN/STRUCT 0/ 2 TO XSECTN/STRUCT 0/ 1
STARTING TIME= 0.00 RAIN DEPTH= 1.00 RAIN DURATION= 1.00 RAIN TABLE NO.= 4 SOIL CONDITION= 3
ALTERNATE NO.= 0 STORM NO.= 0

SUBROUTINE RUNOFF STRUCTURE 2
AREA= 0.07 INPUT RUNOFF CURVE= 76.0 TIME OF CONCENTRATION= 0.27
COMPUTED CURVE NO. = 80.6

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
10.81	4.937	(RUNOFF)
10.96	5.445	(RUNOFF)
15.88	25.818	(RUNOFF)
17.87	29.027	(RUNOFF)
18.93	4.527	(RUNOFF)
19.95	4.526	(RUNOFF)
20.94	4.526	(RUNOFF)
21.94	4.526	(RUNOFF)
22.94	4.534	(RUNOFF)
23.89	4.794	(RUNOFF)

HYDROGRAPH, TZERO= 6.25 DELTA T= 0.25 DRAINAGE AREA= 0.07

TIME											
6.25	DISCHG	0.00	1.43	1.77	2.07	2.34	2.60	2.83	3.05	3.25	3.43
8.75	DISCHG	3.94	4.27	4.13	4.14	4.63	4.93	4.76	4.66	5.16	5.44
11.25	DISCHG	5.15	5.07	5.58	5.91	14.29	18.33	19.32	19.91	22.99	24.60
13.75	DISCHG	25.75	26.46	30.77	32.84	34.00	34.73	78.98	86.99	90.31	91.22
16.25	DISCHG	52.27	36.07	34.35	34.20	28.75	26.49	26.89	27.09	11.05	4.42
18.75	DISCHG	4.31	4.50	3.91	3.66	4.25	4.50	3.91	3.66	4.25	4.50
21.25	DISCHG	3.91	3.67	4.26	4.50	3.92	3.67	4.26	4.51	3.92	3.67
23.75	DISCHG	4.26	4.48	1.43	0.15	0.01	0.00				

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 5.9435 CFS-HRS= 277.32 ACRE-FT= 22.01

SUBROUTINE RESVOR STRUCTURE 2
SURFACE ELEVATION= 735.80

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
16.49	40.152	737.62

HYDROGRAPH, TZERO= 6.25 DELTA T= 0.25 DRAINAGE AREA= 0.07

TIME											
6.25	DISCHG	0.00	0.00	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.08
6.25	ELEV	735.80	735.80	735.80	735.81	735.82	735.82	735.83	735.84	735.85	735.86
8.75	DISCHG	0.09	0.11	0.12	0.14	0.15	0.17	0.19	0.21	0.22	0.24
8.75	ELEV	735.87	735.89	735.90	735.91	735.93	735.94	735.96	735.97	735.99	736.00
11.25	DISCHG	0.26	0.28	0.30	0.30	0.32	0.34	0.36	0.38	0.43	0.51
11.25	ELEV	736.02	736.03	736.05	736.07	736.10	736.15	736.20	736.26	736.32	736.39
13.75	DISCHG	0.60	0.70	0.75	1.26	3.68	5.98	9.76	18.36	27.10	35.01
13.75	ELEV	736.47	736.55	736.63	736.71	736.80	736.88	737.01	737.18	737.36	737.52
16.25	DISCHG	39.58	40.15	39.54	38.88	37.96	36.67	35.43	34.38	32.48	29.40
16.25	ELEV	737.61	737.62	737.61	737.60	737.58	737.55	737.53	737.47	737.47	737.41
18.75	DISCHG	26.29	23.57	21.16	19.00	17.13	15.55	14.14	12.85	11.74	10.83
18.75	ELEV	737.34	737.29	737.24	737.20	737.16	737.13	737.10	737.07	737.05	737.03
21.25	DISCHG	10.01	9.23	8.78	8.45	8.13	7.81	7.52	7.28	7.05	6.81
21.25	ELEV	737.01	737.00	736.98	736.97	736.96	736.95	736.94	736.93	736.92	736.91
23.75	DISCHG	6.60	6.43	6.17	5.77	5.34	4.94	4.57	4.22	3.91	3.61
23.75	ELEV	736.90	736.90	736.89	736.87	736.86	736.84	736.83	736.82	736.81	736.80
26.25	DISCHG	3.34	3.09	2.86	2.64	2.44	2.26	2.09	1.93	1.79	1.65
26.25	ELEV	736.79	736.78	736.77	736.76	736.75	736.75	736.74	736.74	736.73	736.73
28.75	DISCHG	1.53	1.41	1.31	1.21	1.12	1.03	0.96	0.88	0.82	0.79
28.75	ELEV	736.72	736.72	736.71	736.71	736.71	736.70	736.70	736.70	736.70	736.69

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 4.3577 CFS-HRS= 203.35 ACRE-FT= 16.80

SUBROUTINE REACH CROSS SECTION 1
LENGTH= 600.00 INPUT COEFFICIENT= 0.2800 INPUT ROUTINGS= 0.00
AVERAGE WATER VELOCITY= 0.800 ROUTING COEFF= 0.2800 MODIFIED COEFFICIENT= 0.7553

PLATE D-17

NULL STRUCTURE...NO ELEVATIONS GIVEN

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
16.79	39.569	(NULL)

HYDROGRAPH, TZERO= 6.25 DELTA T= 0.25 DRAINAGE AREA= 0.07

TIME										
6.25	DISCHG	0.00	0.00	0.00	0.01	0.02	0.02	0.03	0.04	0.05	0.07
8.75	DISCHG	0.08	0.10	0.11	0.13	0.14	0.16	0.18	0.20	0.21	0.23
11.25	DISCHG	0.25	0.27	0.29	0.30	0.31	0.33	0.35	0.37	0.41	0.47
13.75	DISCHG	0.56	0.65	0.71	1.04	2.60	4.75	7.87	14.28	22.42	30.54
16.25	DISCHG	36.56	39.17	39.56	39.16	38.42	37.33	36.11	34.99	33.43	30.93
18.75	DISCHG	27.97	25.13	22.56	20.25	18.22	16.48	14.96	13.59	12.34	11.37
21.25	DISCHG	10.48	9.68	9.08	8.66	8.32	7.99	7.69	7.42	7.19	6.94
23.75	DISCHG	6.72	6.53	6.30	5.97	5.57	5.16	4.78	4.42	4.09	3.76
26.25	DISCHG	3.50	3.23	2.99	2.77	2.56	2.37	2.19	2.02	1.87	1.73
28.75	DISCHG	1.60	1.48	1.37	1.27	1.17	1.08	1.00	0.93	0.86	0.80

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 4.3550 CFS-HRS= 205.20 ACRE-FT= 16.79

SUBROUTINE RUNOFF STRUCTURE 1
AREA= 0.16 INPUT RUNOFF CURVE= 76.0 TIME OF CONCENTRATION= 0.25
COMPUTED CURVE NO. = 88.6

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
10.00	11.086	(RUNOFF)
10.98	12.236	(RUNOFF)
15.87	215.736	(RUNOFF)
17.87	65.548	(RUNOFF)
18.93	10.168	(RUNOFF)
19.93	10.183	(RUNOFF)
20.93	10.196	(RUNOFF)
21.93	10.175	(RUNOFF)
22.93	10.196	(RUNOFF)
23.89	10.926	(RUNOFF)

HYDROGRAPH, TZERO= 6.00 DELTA T= 0.25 DRAINAGE AREA= 0.16

TIME										
5.00	DISCHG	0.00	2.22	3.28	4.02	4.69	5.30	5.86	6.38	6.87	7.32
9.50	DISCHG	7.75	8.91	9.61	9.22	9.29	10.45	11.08	10.50	10.45	11.65
11.00	DISCHG	12.23	11.49	11.37	12.58	15.15	33.66	41.43	43.42	44.71	52.03
13.50	DISCHG	55.29	57.88	59.36	69.64	73.79	76.37	77.69	165.79	196.27	202.79
16.00	DISCHG	204.51	110.54	79.43	76.72	76.64	63.51	59.18	60.32	60.85	21.78
18.50	DISCHG	9.36	9.67	10.10	8.67	8.18	9.64	10.11	8.68	8.20	9.64
21.00	DISCHG	10.13	8.66	8.20	9.64	10.12	8.68	8.19	9.66	10.13	8.69
23.50	DISCHG	8.21	9.65	10.14	2.63	0.23	0.00	0.00			

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 5.9358 CFS-HRS= 620.58 ACRE-FT= 51.28

SUBROUTINE ADDHYD STRUCTURE 1
INPUT HYDROGRAPHS= 5,6 OUTPUT HYDROGRAPH= 7

DUE TO STORAGE OVERFLOW, THE SUM OF HYDROGRAPHS 6 AND 5 WAS TRUNCATED HERE TO 100 VALUES.

100 YR FLOOD
INFLOW LOWER DAM

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
9.03	9.731	720.25
10.00	11.254	720.44
10.98	12.477	720.61
15.90	242.858	721.55
20.70	22.056	720.85
21.88	19.005	720.79
22.90	17.715	720.77
23.88	17.542	720.77

HYDROGRAPH, TZERO= 6.00 DELTA T= 0.25 DRAINAGE AREA= 0.23

TIME										
6.00	DISCHG	0.00	2.22	3.28	4.03	4.70	5.32	5.89	6.42	6.92	7.39
8.50	DISCHG	7.83	9.00	9.71	9.33	9.42	10.60	11.25	10.68	10.65	11.87
11.00	DISCHG	12.47	11.75	11.64	12.88	13.45	33.98	41.76	43.77	45.08	52.44
13.50	DISCHG	55.76	58.44	60.02	70.36	74.83	76.98	78.44	173.66	210.56	223.22
16.00	DISCHG	235.06	147.11	118.61	116.28	115.80	101.93	96.51	96.44	95.95	55.22
18.50	DISCHG	40.29	37.65	35.23	31.23	28.44	27.87	26.59	23.64	21.79	22.03
21.00	DISCHG	21.50	19.13	17.48	18.72	18.79	17.01	16.19	17.35	17.56	15.56
23.50	DISCHG	15.16	16.38	16.67	8.94	6.20	5.58	5.16	4.78	4.42	4.09
26.00	DISCHG	3.78	3.50	3.23	2.99	2.77	2.56	2.37	2.19	2.02	1.87
28.50	DISCHG	1.73	1.60	1.48	1.37	1.27	1.17	1.08	1.00	0.93	0.86

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 5.4465 CFS-HRS= 725.56 ACRE-FT= 59.05

SUBROUTINE SAVMOV STRUCTURE 1

PLATE D-18

100 YR FLOOD
OUTFLOW LOWER DAM

INPUT HYDROGRAPH= 7 OUTPUT HYDROGRAPH= 8

SUBROUTINE RESVOR STRUCTURE 1
SURFACE ELEVATION= 718.50

PEAK TIMES 15.90 PEAK DISCHARGES 235.36 PEAK ELEVATIONS 721.54

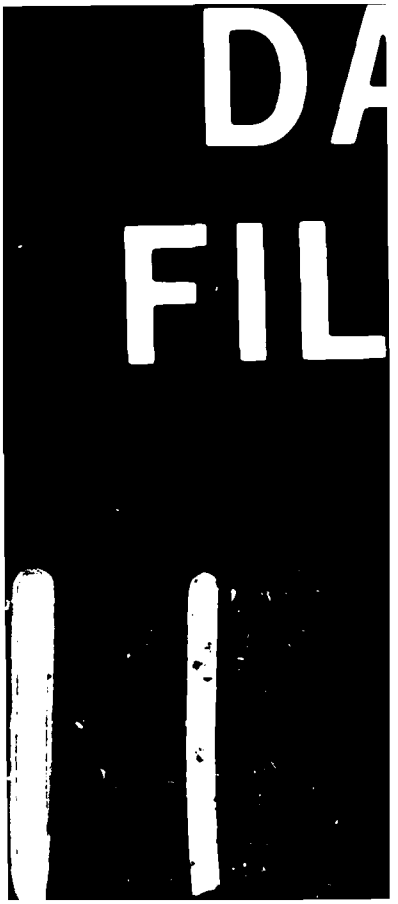
HYDROGRAPH, IZERO= 6.00 DELTA T= 0.25 DRAINAGE AREA= 0.25

TIME											
6.00	DISCHG	0.00	0.01	0.05	0.10	0.16	0.23	0.31	0.39	0.48	0.57
6.00	ELEV	718.50	718.50	718.52	718.54	718.56	718.59	718.62	718.66	718.70	718.74
8.50	DISCHG	0.66	0.74	0.84	0.94	1.04	1.20	1.46	1.71	1.94	2.19
8.50	ELEV	718.78	718.82	718.87	718.92	718.97	719.02	719.07	719.12	719.17	719.22
11.00	DISCHG	2.48	2.78	3.06	3.35	3.66	4.64	5.50	7.01	8.52	10.15
11.00	ELEV	719.28	719.33	719.37	719.42	719.47	719.58	719.75	719.95	720.11	720.30
13.50	DISCHG	11.88	14.68	25.08	40.36	60.82	71.03	77.17	122.14	189.56	225.15
13.50	ELEV	720.52	720.72	720.90	721.04	721.13	721.18	721.21	721.35	721.49	721.55
16.00	DISCHG	231.63	182.59	134.67	118.07	116.12	109.13	99.58	96.59	96.16	79.26
16.00	ELEV	721.54	721.47	721.36	721.32	721.32	721.30	721.28	721.27	721.27	721.22
18.50	DISCHG	59.26	46.38	40.07	35.73	31.99	30.46	29.71	28.64	27.26	26.01
18.50	ELEV	721.13	721.07	721.04	721.02	721.00	720.99	720.97	720.96	720.93	720.91
21.00	DISCHG	25.02	23.93	22.66	21.65	20.97	20.25	19.40	18.79	18.48	18.07
21.00	ELEV	720.89	720.88	720.86	720.84	720.83	720.82	720.80	720.79	720.79	720.78
23.50	DISCHG	17.47	17.07	16.95	15.98	14.02	12.96	12.72	12.48	12.23	11.98
23.50	ELEV	720.77	720.76	720.76	720.74	720.71	720.68	720.64	720.61	720.57	720.54
26.00	DISCHG	11.72	11.40	11.08	10.75	10.44	10.12	9.81	9.51	9.21	8.91
26.00	ELEV	720.50	720.46	720.42	720.38	720.34	720.30	720.26	720.22	720.19	720.16
28.50	DISCHG	8.62	8.34	8.07	7.80	7.54	7.28	7.03	6.79	6.55	6.32
28.50	ELEV	720.12	720.09	720.06	720.03	720.00	719.97	719.94	719.91	719.88	719.85

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 5.0373 CFS-HRS= 761.70 ACRE-FT= 62.94

ENDCMP 1

PLATE D-19


DA
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